COLUMBIA RIVER CHANNEL IMPROVEMENT STUDY

WILDLIFE MITIGATION PLAN

1. INTRODUCTION

The development of a wildlife mitigation plan for the Columbia River Channel Deepening Feasibility Study is an interagency effort. It involves personnel from the U. S. Army Corps of Engineers, Washington Departments of Fish and Wildlife and Ecology, U. S. Fish and Wildlife Service, and the Oregon Department of Fish and Wildlife. The U. S. Army Corps of Engineers serves as liaison for the interagency wildlife mitigation team to the Port of Portland which represents the seven lower Columbia River Ports, e.g., Portland, Vancouver, Woodland, St. Helens, Kalama, Longview, and Astoria, who are the local sponsors for the Feasibility Study.

The wildlife mitigation planning effort focused on the 43-foot channel improvement alternative. This structural alternative represents the maximum impact to wildlife habitat and resources from project implementation. Other alternatives would have less impact if implemented and represent subsets of the disposal sites required for the 43-foot alternative. The mitigation plan for a lesser alternative than the 43-foot channel would simply be a subset of the mitigation features determined for that alternative.

2. PROJECT DESCRIPTION

The Columbia and Lower Willamette Rivers navigation project was first authorized in 1878, and the channel has been deepened at intervals since that time. The project authorization, as modified by Congress in 1962, covers 14.6 miles of Willamette River below Portland, Oregon, and 103.5 miles of Columbia River below Vancouver, Washington (figure 1). Work on the authorized 40-foot deep channel from Portland and Vancouver to the sea was complete in 1976. The Willamette River channel, from the Broadway Bridge (WRM 11.6) to the mouth (WRM 0), varies in width from 600 to 1,900 feet. On the Columbia River, the project provides for a channel 35 feet deep and 500 feet wide from the Interstate 5 bridge to the Burlington-Northern Railroad bridge (CRM 106.5 to 105.5). The Columbia River channel for the four miles between the mouth of the Willamette River and the railroad bridge at Vancouver is being maintained to a 500-foot width until the need for a wider channel is demonstrated. The rest of the Columbia River channel from the railroad bridge to near the river's mouth (CRM 3) is 40 feet deep and 600 feet wide. Turning basins on the Columbia River are provided at Vancouver, Kalama, and Longview in Washington, and at Astoria in Oregon. The project also includes 30- and 24-foot deep auxiliary channels from the Columbia River channel at St. Helens (CRM 87) and Rainier (CRM 68), respectively.

2.1. Alternatives

2.1.1. No Action Alternative

The no action alternative (without-project condition) is the most likely condition expected to prevail over the length of the planning period in the absence of the Federal Government (Corps) implementing a plan to improve deep-draft transport on the navigation channel. It is the most probable future without project condition and also provides the baseline for estimating direct and indirect impacts associated with the proposed alternatives.

The no action alternative assumes that the navigation channel would continue to be maintained at its existing dimensions (40 feet deep by 600 feet wide), and that the DMMP (1998) would be implemented to maintain the channel in the future. The target drafts for container ships and bulk carriers would remain at 36 feet and 40 feet, respectively. The maximum draft in the river would remain at 40 feet for all ships. There would be some changes in future maintenance dredging and disposal practices, as identified in the DMMP and summarized in the next section.

No mitigation actions would be enacted for the no action alternative as it utilizes existing dredged material disposal locations.

2.1.2. Non-Structural Alternative

The non-structural alternative consists of upgrading the existing river stage forecasting system (called *Loadmax*) to enable ships to determine navigable channel depths based upon projected future and real-time tide and river stage information.

An analysis of navigation practices on the Columbia River found that available water depths were not fully utilized by ships, even by the deepest 90 percent of the fleet. Vessels sailing at the target drafts shown in table 2 commonly have underkeel clearances of one to four feet greater than the minimum allowable clearances. Most container lines target a 36-foot draft and only schedule enough outbound cargo to reach that draft. Because cargo is not scheduled at the dock, container ships with design drafts of 38 to 41 feet can not take advantage of the water depths available at their scheduled sailing time. Bulk carriers make better use of available water depths because their sailing draft is selected just hours prior to departure. The bulk carriers can also delay departure to wait for maximum water depths.

There are several limitations to the existing river stage forecasting system that prevent shippers from making maximum use of the available water depths in the Columbia River.

- Concern about the accuracy of the river stage forecast.
- The river stage forecast is presented for only six locations, and does not present a clear picture of expected river conditions.
- Since navigation channel bed elevations are not included in the forecast, the total water depth available is not available.
- The six-day forecast does not allow enough time for container lines to schedule cargo to take full advantage of expected water depths.

It would be possible to improve the river stage forecasting system (*Loadmax*) to overcome the above limitations. New technology and better use of available data would improve the reliability and usefulness of the forecasts. Updated one- and two-dimensional hydraulic models could be used to improve the accuracy of the stage forecast. These models would also provide a continuous water surface profile along the entire channel, rather than just at the current six locations. The water surface elevations forecast for the six gage locations could be regularly compared to the observed elevations to monitor and maintain the accuracy of the forecasts. The controlling depths from Corps' navigation surveys could be combined with the water surface profiles to provide a forecast of total water depth available along the entire navigation channel.

The Columbia River hydropower system reservoir operation forecasts could be used to provide expected river discharges for up to a month in advance, which could then be used to provide advanced river stage forecasts. Although there would be more uncertainty with such long-range forecasts, it could allow container lines to schedule cargo to take advantage of potential higher river stages.

Dredging and dredged material disposal requirements for the non-structural alternative are comparable to the no action alternative. Thus, no mitigation actions are forecast for the non-structural alternative.

2.1.3. Structural Alternatives

2.1.3.1. Regional Port Alternatives

In response to public comments on reducing the environmental impacts associated with dredging, several alternatives have been formulated which involve the development of new port facilities closer to the mouth of the Columbia River. Two alternatives involve the construction of topping-off facilities located at the Ports of Astoria (CRM 13) or Longview (CRM 65). Two additional alternatives involve the construction of all export facilities at either Astoria or Longview to fully load any vessel that would depart the river at drafts greater than 40 feet (single-stop port).

The four alternatives for regional port facilities were dropped from further consideration as it was determined that the potential sites lacked existing port and transportation infrastructure and/or the land base for port facilities of the magnitude required. The construction, transportation and environmental costs associated with implementing the regional port alternatives were greater than other study alternatives under consideration.

2.1.3.2. Channel Improvement Alternatives

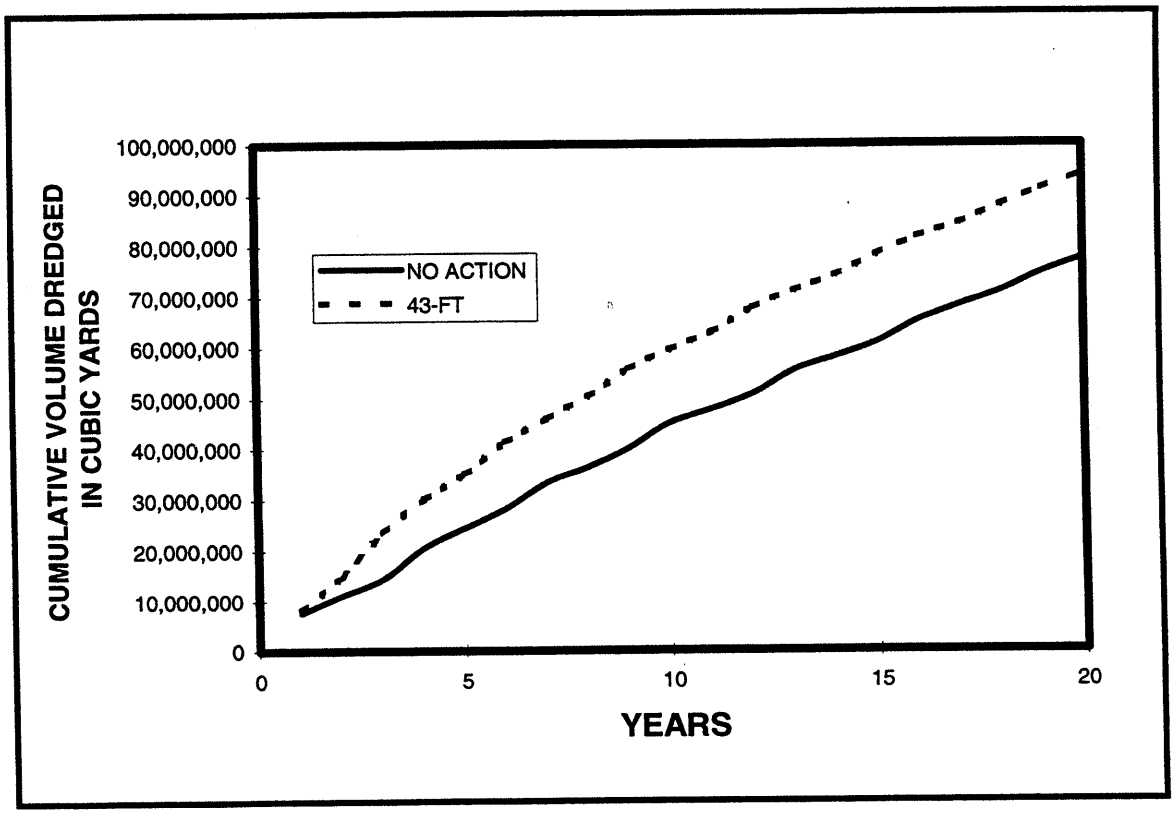
The three channel improvement alternatives include deepening the existing 40-foot navigation channel to 41, 42, or 43 feet. These alternatives retain the existing channel alignment from CRM 3 to CRM 105.5 and the existing 600-foot width. For the Willamette River, a narrower channel was selected because of the small volume of ship traffic that would likely exceed the existing 40-foot depth.

The construction of the 41-, 42-, and 43-foot channels would require dredging 4.7 mcy, 10.8 mcy, and 18.7 mcy from the navigation channel, respectively. Construction of the 43-foot channel would also require the removal of 255,000 cubic yards of hard basalt rock and 246,000 cubic yards of cemented sand, gravel and boulders. Underwater blasting would be used to remove this material. Most construction dredging would be done by hopper and pipeline dredges.

Each navigation alternative, including no action, required maintenance dredging forecasts that covered the range of available disposal options. The dredging forecasts were made using the observed dredging trends and potential sediment supplies. Where recent disposal practices have been adding to the sediment supply, two forecasts were made; one for a continuation of recent disposal practices and another that incorporated removing the dredged material from the sediment supply. A third maintenance dredging forecast was made for sites where river control structures have the potential to further reduce sediment supply. These sites include the St. Helens, Westport, Pillar Rock, and Miller Sands bars.

The dredging expected at each bar was forecast based on disposal methods and/or river control structures included in the options. The individual bar forecasts were then compiled into overall river forecasts for each channel improvement alternative. The 20-year maintenance dredging forecasts for the no action alternative and the 43-foot channel alternative are shown in figure 1. After 20 years, both forecasts predict a decline over time in annual dredging. The expected decline in annual dredging would be related to reductions in the potential sediment supply.

Figure1 -- Maintenance Dredging Forecasts (cumulative volume for 20 year period)



Dredged material disposal entails four basic approaches, e.g. inwater, beach nourishment, upland and/or offshore placement. This wildlife mitigation effort addresses upland disposal, principally the placement of dredged material at upland locations where material has never been placed previously. These new upland locations contain wildlife habitat and support resident, wintering and/or breeding populations of wildlife. Riparian and/or wetland habitat associated with historic or present disposal sites for the existing 40-foot channel and subject to impact from disposal actions associated with the structural (41, 42 or 43-foot channel depth) alternative would also be mitigated.

Location and acreage of disposal sites varies throughout the study area as a function of river depth and shoaling areas. Large disposal sites or a number of different disposal sites are required in close proximity to areas where substantial dredging would be required to deepen the river to project depth or where natural conditions lead to shoaling of material.

This feasibility study has placed a greater emphasis on upland disposal as beach nourishment, a traditional disposal means, has been significantly reduced in recent years because of Endangered Species Act concerns for listed salmonids. Beach nourishment typically occurs in naturally erosive environments and can lead to substantial rehandling of dredged material on an annual basis. Inwater disposal has also been reduced, because of high volumes, fisheries concerns, and/or lack of deep water disposal sites throughout the study area. These factors, coupled with the high transport cost to move dredged material any distance, have contributed to the increased emphasis on upland locations for disposal.

Two alternative disposal plans (Table 1), the Government (Section 2.1.3.2.1) and Sponsor's Preferred (Section 2.1.3.2.2), are under consideration to accomplish the structural alternative. These disposal plans are based upon the 43-foot structural alternative. Acreage required for upland disposal will not change between the 41', 42' and 43' structural alternatives for channel improvement. Rather, one would see a decrease in height of dredged material placed at a given location as the lesser channel depths are considered.

2.1.3.2.1. Government Disposal Plan

This plan provides disposal capacity adequate for construction and 20 years of maintenance dredging at the least overall cost, while meeting the environmental and engineering criteria to the extent practicable (Table 2). The Government Disposal Plan was developed for the 43-foot channel improvement plan because it has the largest volume of dredging and disposal. The disposal plan for the 41-foot and 42-foot plans would be similar to that of the 43-foot plan. Because of the uncertainties in maintenance dredging volumes, land use changes, environmental regulations and technical advances, only a general concept is provided for disposal during years 21 to 50 of the proposed project.

The methods used to evaluate potential disposal sites were the same as those used in the DMMP, or No Action Alternative. The need for disposal capacity for construction and maintenance of a deeper channel and reduced in-water disposal capacity were the main factors that caused differences in the Government Disposal Plan and the No Action Alternative. Both disposal plans rely on upland and flowlane disposal, and minimize the use of shoreline disposal.

The Government Disposal Plan utilizes the 31 upland disposal sites listed in Table 1, with a total area of 1,886 acres. Fifteen of the eighteen upland sites in the no action alternative are also included in the Government Disposal Plan. Disposal sites W-95.8 and W-45.0 were not included in the Government Plan because they lacked the capacity required for disposal should a channel deepening alternative be implemented. Site W-42.5 was also not included in the Government Plan as it did not meet the least cost requirements for disposal in that reach.

Six of the proposed upland sites have not been used for disposal and the remaining 25 were all used for disposal in the past. Mitigative actions are proposed for habitat impacts at 16 of the 31 sites in the Government Disposal Plan. Ten former disposal sites either contain early successional stage riparian habitat or else their boundaries were expanded and thus encompassed habitat requiring mitigation.

Table 1. Summary of Disposal Alternatives.

Sites Considered[1/]	Type of Disposal Site	Disposal History[2/]	Alternatives		
			No Action	Government	Sponsor
CRM 3-106 3 5'-65' deep in or adjacent to channel	Open Water, Unrestrained	Used[1,2,3]	45-65' deep in or adjacent to channel	50-65' deep in or adjacent to channel	50-65' deep in or adjacent to channel
Hayden O-105.0	Upland/ Beach Nourish	Used[1,2,3]	79 acres Upland	102 acres Upland	102 acres Upland
Gateway 3 W-101	Upland	New			93 acres
O-98.5 (Sauvie 1)	Upland	New		48 acres	
W-97.1	Upland	Used[2,3]	27 acres	27 acres	27 acres
W-96.9	Upland	New		17 acres	
W-96.5	Upland	New		25 acres	
W-95.7	Upland	New		25 acres	
Dairy	Upland	New		107 acres	
Austin Point	Upland	Used[3]		26 acres	26 acres
W-95.8	Upland	Used[3]	13 acres		
Lonestar	Gravel Pit	New			113 acres
RR Corridor	Upland	Used[3]			12 acres
O-86.2	Beach Nourish	Used[2,3]		28 acres Beach Nourish	28 acres Beach Nourish
O-82.6 Reichold	Upland	Used[3]			49 acres
W-82.0	Upland	Used[3]		32 acres	32 acres
Morse Pit	Gravel Pit	New			82 acres
Martin Island	Upland	New		80 acres	
O-77.0	Upland	Used[3]		29 acres	29 acres
O-75.8	Beach Nourish/ Upland	Used[2,3]	30 acres Upland	30 acres Upland	30 acres Upland
Peavey Oval	Upland	Used[2,3]		43 acres	43 acres
W-72.2 (Northport)	Upland	Used[2,3]			50 acres
W-70.1 (Cottonwood Is)	Upland	Used[2,3]		50 acres	50 acres
W-68.7 (Howard Is.)	Upland	Used[2,3]	200 acres	200 acres	200 acres
W-67.5	Upland/	Used[1,2]			8 acres

Table 1. Summary of Disposal Alternatives. (Continued)

Sites Considered[1/]	Type of Disposal Site	Disposal History[2/]	Alternatives		
			No Action	Government	Sponsor
O-67.0 Rainier Beach	Upland	Used[3]		52 acres	
O-65.7	Beach Nourish/ Upland	Used[1,2,3]	73 acres Upland	73 acres Upland	73 acres Upland
O-64.8	Beach Nourish/ Upland	Used[1,2,3]	53 acres Upland	53 acres Upland	53 acres Upland
O-63.5	Upland	Used[1,2,3]	28 acres Upland	46 acres	46 acres
W-63.5	Upland	Used[1,2,3]		13acres	13 acres
W-62.0	Upland	New		50 acres	50 acres
W-59.7	Upland	Used[1,2,3]	69 acres	69 acres	69 acres
O-57.0	Beach Nourish/ Upland	Used[1,2,3]	51 acres Upland	51 acres Upland	51 acres Upland
Port Westward	Upland	Used[3]		50 acres	50 acres
W-46.0/46.3	Beach Nourish/ Upland	Used[1,2,3]	72 acres Upland	72 acres	72 acres
W-44.0	Upland	New		100 acres	100 acres
W-45.0	Beach Nourish/ Upland	Used[2,3]	15 acres Upland		
O-42.9	Upland	Used[1,2,3]	59 acres Upland	59 acres	59 acres
W-42.5	Beach Nourish/ Upland	Used[2,3]	28 acres Upland		
O-38.3	Beach Nourish/ Upland	Used[1,2,3]	42 acres Upland	42 acres	42 acres
O-34.0 Welch Is.	Beach Nourish/ Upland	Used[2,3]	42 acres Upland	42 acres	42 acres
O-27.2 Pillar Rock	Upland/Beach Nourishment	Used[1,2,3]	56 acres Upland	56 acres	56 acres

Table 1. Summary of Disposal Alternatives. (Continued)

SITES CONSIDERED[1/]	TYPE OF DISPOSAL SITE	DISPOSAL HISTORY[2/]	ALTERNATIVES		
			NO ACTION	GOVERNMENT	SPONSOR
O-23.5 Miller Sands	Beach Nourish	Used[1,2,3]	151 acres BN with Pile Dikes	151 acres BN with Pile Dikes	151 acres BN with Pile Dikes
W-21.0 Rice Island	Beach Nourish/ Upland	Used[1,2,3]	228 acres Upland	228 acres Upland	228 acres Upland
RM 21.0 Harrington Point Sump	Open Water, Unrestrained	Used[1,2,3]	118 acres Open Water, Unrestrained	118 acres Open Water, Unrestrained	118 acres Open Water, Unrestrained
Ocean	Designated Open Water	New	Designated Open Water	Designated Open Water	Designated Open Water
Miller/Pillar	Open Water, Unrestrained	New 162 acres		New 162 acres	New 162 acres

1/ Sites Considered: "W"/ "O" refer to the Washington or Oregon shoreline respectively; the number refers to approximate river mile on the navigation channel.

2/ Disposal History Based on 1995 information:

1 - Site has been used within the last 2 years
2 - Site has been used within the last 10 years
3 - Site was used over 10 years ago

Table 2. Government Disposal Plan Disposal Sites.

Disposal Site	Location	Use in 20-Year Term	Site Acres	Site Capacity in cu. yds.	Disposal Volume in cu. yds.	Final Height in feet
Site O-105.0	West Hayden Island	2003-2022	102	5,750,000	5,330,000	58
Site O-98.5	Sauvie Island	2003-2022	48	2,323,000	1,542,000	40
Site W-97.1	Fazio Sand & Gravel	2003-2009	27	650,000	650,000	25
Site W-96.9	Adjacent Fazio	2003-2022	17	475,000	475,000	44
Site W-96.5	N. Dike Field	2006-2022	25	1,098,000	1,098,000	53
Site W-95.7		2003-2006	25	1,080,000	650,000	38
Site O-90.6	Scappoose Dairy	2003-2022	107	5,350,000	5,307,400	51
Site W-86.5	Austin Point	2003-2022	26	1,645,000	1,645,000	65
Site O-86.2	Sand Island	2003-2022	28	1,250,000	1,250,000	15
Site W-82.0	Martin Bar	2003-2006	32	1,500,000	1,500,000	65
Site W-80.0	Martin Island	2003-2022	80	3,850,000	2,946,000	36
Site O-77.0	Lower Deer Island	2002-2020	29	1,498,000	1,100,000	64
Site O-75.8	Sandy Island	2002-2019	30	1,100,000	1,100,000	53
Site W-73.5	Peavy Rail Oval, Kalama	2002-2021	43	900,000	1,220,000	34
Site W-70.1	Cottonwood Island	2002-2021	50	3,225,000	2,506,000	54
Site W-68.7	Howard Island	2002-2021	200	6,400,000	3,710,000	37
Site O-67.0	Rainier Beach	2002-2003	52	1,095,000	1,095,000	36
Site O-65.7	Globe Quarry	2002-2018	73	2,950,000	2,950,000	60
Site O-64.8	Rainer Industrial	2003-2021	53	2,235,000	2,235,000	65
Site O-63.5	Lord Island - Upstream	2002-2014	46	1,255,000	1,255,000	41

Table 2. Government Disposal Plan Disposal Sites. (Continued)

Disposal Site	Location	Use in 20-Year Term	Site Acres	Site Capacity in cu. yds.	Disposal Volume in cu. yds.	Final Height in feet
Site W-63.5	Reynolds Aluminum	2002	13	500,000	500,000	35
Site W-62.0	Mt. Solo	2002-2021	50	2,420,000	2,230,000	34
Site W-59.7	Hump Island	2002-2009	69	1,400,000	1,400,000	40
Site O-57.0	Crims Island	2002-2021	51	1,600,000	1,600,000	48
Site O-54	Port Westward	2002-2021	50	1,875,000	1,875,000	46
Site W-46.3	Brown Island	2002-2021	72	3,700,000	3,700,000	42
Site W-44.0	Puget Is. (Vik Property)	2002-2021	100	3,200,000	3,200,000	33
Site O-42.9	James River	2002-2021	59	1,280,000	1,106,000	42
Site O-38.3	Tenasillahe Island	2003-2022	42	2,100,000	2,100,000	53
Site O-34.0	Welch Island	2017-2021	42	446,000	446,000	25
Site O-27.2	Pillar Rock Island	2003-2021	56	2,555,000	2,540,000	52
Site O-23.5	Miller Sands	2003-2021	151		1,405,600	
Site W-21	Rice Island	2003-2021	228	5,500,000	5,500,000	45

The Government Disposal Plan involves a variety of in-water disposal actions. There would be two beach nourishment sites (O-23.5 and O-86.2), an in-water fill at CRM 25 to 27, and flowlane disposal along the length of the navigation channel. There would also be ocean disposal during construction and maintenance dredging. The in-water fill would be part of a proposed ecosystem restoration project to restore shallow water areas between Miller Sands and Pillar Rock Islands that have been lost due to channel erosion over the past 20 years. Over 150 acres that are now 25 to 30 feet deep would be filled to approximately their pre-erosion condition (about 5 feet deep) and stabilized by pile dikes. The restoration project was originally identified in the *Long Term Management Strategy for Dredged Material Disposal in the Columbia River Estuary* (Corps of Engineers, 1990).

Flowlane disposal would generally occur in water depths of 50 to 65 feet. However, there would be several exceptions to the general flowlane criteria. Flowlane disposal would occur in areas with depths of 35 to 65 feet between CRM 64 and 68, and between CRM 90 and 101. Flowlane disposal would occur in areas over 65 feet deep in five specific areas: downstream of CRM 5; CRM 29 to 35; CRM 39 to 40; CRM 54 to 56.3 in the Oregon half of the channel; and CRM 72.2 to 73.2 in the Washington half of the channel.

2.1.3.2.2 Sponsor's Preferred Disposal Alternative

In addition to the standard Corps planning guidelines, the sponsoring ports applied the following guidelines during the selection of their preferred disposal plan:

- Utilize Columbia River sand for port purposes and other beneficial uses.
- Substitute transportation costs for environmental costs.
- Minimize acquisition costs and enhance feasibility by avoiding controversial sites.

The sponsors were willing to incur some additional project cost to satisfy the above local guidelines. Alternatives considered by the sponsors included double handling dredged material to dispose of it in fewer but larger disposal sites; maximize use of sponsor-owned property; and use of existing sand and gravel mining operations.

The sponsor's preferred disposal alternative would be similar to the Government Disposal Plan, except for seven of the upland disposal sites. The sponsor's alternative trades some of the sites in the Government Disposal Plan that would require mitigation, for more costly sites that provide material for future commercial/industrial uses or do not require mitigation. Implementation of the Sponsor Disposal Plan would require mitigation of wildlife habitat losses at 13 locations. Of the seven alternate upland disposal sites included in the sponsor's alternative, four sites are located on Port-owned lands at Vancouver, St. Helens, Kalama and Longview. Two other sponsor's sites are at active sand and gravel mining operations. The site differences between the least cost and sponsor's disposal alternatives are shown in Table 3.

Table 3. Site Differences Between Disposal Alternatives and Site Use in the 20-year term for those Sponsor Preferred Sites not in the Government Plan.

Least Cost Plan Disposal Sites Dropped	**Sponsor Preferred Plan** Disposal Sites Added	**Sponsor Preferred Plan Site Use in 20-yr Term**
Sauvie 1 (O-98.5)	Gateway 3	2003-2022
W-96.9	Lonestar	2003-2022
W-96.5	Railroad Corridor	2003-2004
W-95.7	O-82.6	2003-2021
Dairy	Morse Bros.	2003-2022
	W-73.5	2004-2022
Martin Island	Northport (W-72.2)	2004-2009
Rainier Beach (O-67.0)	W-67.5	2002-2021

3. WILDLIFE MITIGATION PLANNING AND ANALYSIS

Regardless of the disposal plan considered, upland disposal locations have been proposed for agricultural lands (e.g., row crop, pasturelands), former and present dredged material disposal sites, and lands zoned or currently used for industrial purposes (Tables 4 and 5). The riparian, wetland and agricultural habitats associated with some of the proposed disposal locations help support numerous species of wildlife that occur along the lower Columbia River. These include substantial populations of wintering waterfowl, Neotropical migrant birds, raptors, small mammals, reptiles, amphibians and other species. Thus, wildlife mitigation efforts would be required to offset impacts to these habitats and their constituent species.

Initial mitigation efforts centered upon avoidance and minimization of impacts to wildlife habitat, to the extent practicable, during selection of dredged material disposal sites. Avoidance was partially accomplished by focusing disposal siting efforts on existing and previously used disposal sites (Tables 4 and 5). The application of environmental criteria was used to avoid sites with wetland and riparian habitats or important wildlife resources, to the extent practicable. Adjustment of disposal site boundaries to avoid riparian and wetland habitat, based upon site visits and review of aerial photography, was also employed. Riparian habitat within 300' of the Columbia River, listed as Critical Habitat for Snake River salmonids, was avoided. Beach nourishment, a historical practice for disposal of dredged material along the shores of the Columbia River has largely been abandoned. Beach nourishment disposal often resulted in substantial rehandling of dredged material that eroded from the shoreline and redeposited in the navigation channel. The practice may also adversely impact fisheries habitat. Minimization was employed by essentially stacking dredged material higher on individual sites rather than expanding a site's footprint. This reduced the acreage required for disposal of dredged material.

The result of avoidance and minimization measures, when new upland disposal sites were required, was to focus dredged material disposal for the proposed project on agricultural lands. New upland sites in the Government Disposal Plan (Table 4) and Sponsor's Preferred Disposal Plan (Table 5) were usually landward of protective dikes along the Columbia River shoreline. Agricultural lands provide wildlife habitat for a number of wildlife species, particularly wintering Canada geese and other waterfowl. Riparian and wetland habitat were impacted to a substantially lesser degree than agricultural habitat (Tables 4 and 5).

Table 4. Habitat composition and acreage for proposed disposal sites, Government Disposal Plan.

PROPOSED DISPOSAL SITE	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	EXISTING SITE UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 1- Columbia River Miles 98-105						
O-105 – W. Hayden Island	102	0	0	0	102	0
O-98.5 – Sauvie 1	48	48	0	0	0	0
REACH 2 – Columbia River Miles 84-98						
W-97.1 - Fazio S&G	27	0	0	0	27	0
W-96.9 - Adj. Fazio S&G	17	8.2	0	0	8.8	0
W-96.5 – N. Dike Field	25	25	0	0	0	0
W-95.7	25	25	0	0	0	0
O-90.6 – Scappoose Dairy	107	99.3	7.7	0	0	0
W-86.5 - Austin Point	26	0	0	2.7	23.3	0
O-86.2 - Sand Is.	28	0	0	0	28	0
REACH 3 – Columbia River Miles 70-84						
W-82.0 - Martin Bar	32	0	0	2.9	29.1	0
W-80.0 - Martin Island	80	79.7	0	0.3	0	0
O-77.0 - Deer Island	28.8	0	0	*	28.8	0
O-75.8 - Sandy Island	30	0	0	0	30	0
W-73.5 - Peavy Oval	43	0	0	0	43	0
W-70.1- Cottonwood Island	50	0	0	5	45	0
REACH 4 – Columbia River Miles 56-70						
W-68.7 - Howard Is.	200	0	0	20	180	0
O-67.0 – Rainier Beach	52	0	0	0	52	0
O-65.7	73	0	0	0	73	0
O-64.8	53	0	0	8.2	44.8	0
O-63.5	45.9	0	0	17.5	28.4	0
W-63.5	13	0	0	0	13	0
W-62.0 - Mt. Solo	50	25	25	0	0	0
W-59.7 - Hump Island	69	0	0	7	62	0
O-57.0	51	0	0	0	51	0
REACH 5 – Columbia River Miles 41-56						
O-54.0 - Port Westward 1	50				50	0
W-46.3 & W-46.0 – Brown Is.	72	0	0	0	72	0
W-44.0 - Puget Island	100	88.2	5.4	2.6	0	3.8
O-42.9	59	0	0	0	59	0
REACH 6 – Columbia River Miles 29-41						
O-38.3 – Tenasillahe Island	42	0	0	0	42	0
O-34.0 - Welch Island	42	0	0	0	42	0

Table 4. Habitat composition and acreage for proposed disposal sites, Government Disposal Plan. (Continued)

PROPOSED DISPOSAL SITE	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	EXISTING SITE UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 7 – Columbia River Miles 3-29						
O-27.2 - Pillar Rock Island	55.6	0	0	0	55.6	0
O-23.5 - Miller Sands Spit	151	0	0	0	151	0
W-21.0 - Rice Island	228	0	0	0	228	0
Totals	2075.3	398.4	38.1	66.2	1568.8	3.8

*Riparian habitat will develop in TY 5 and will be mitigated for in analysis.

Where avoidance and minimization measures were impracticable, resulting in a proposed selection of new upland disposal sites that contained wildlife habitat and supported wildlife resources, compensatory mitigation actions were instigated. Compensatory mitigation is simply the restoration or development of wildlife habitat to replace those wildlife values lost due to project related actions. Compensatory mitigation for upland disposal impacts to wildlife habitat is being given full consideration through administration of the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures process. To determine compensatory mitigation levels, an interagency wildlife mitigation team was formed. The team consists of representatives from the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Washington Department of Ecology and a representative of the Ports.

Table 5. Habitat composition and acreage for proposed disposal sites, Sponsor Disposal Plan.

PROPOSED DISPOSAL SITE	SITE ACREAGE	AGRICULT. CROPLAND	WETLAND	RIPARIAN	UPLAND DREDGED MATERIAL	OTHER (Roads, Barns, Houses)
REACH 1- Columbia River Miles 98-105						
O-105 - Hayden Island	102	0	0	0	102	0
W-101 Gateway 3	93	93	0	0	0	0
REACH 2 – Columbia River Miles 84-98						
W-97.1 - Fazio S&G	27	0	0	0	27	0
Lonestar Gravel Pit*	113	3		2		113
Railroad Corridor	12	0	0	0	12	0
Austin Point	26	0	0	2.7	23.3	0
O-86.2-Sand Is. (Beach Nourish.)	28	0	0	0	28	0
REACH 3 – Columbia River Miles 70-84						
O-82.6 Reichold	49	0	0	0	49	0
W-82.0 - Martin Bar	32	0	0	2.9	29.1	0
Morse Bro. Gravel Pit	82	0	0	0	0	82
O-77.0 - Deer Island*	28.8	0	0	0	28.8	0
O-75.8 - Sandy Island*	30	0	0	0	30	0
W-73.5 (Peavy Oval)	43	0	0	0	43	0
W-72.2	50	0	0	0	50	0
W-70.1- Cottonwood Island	50	0	0	5	45	0
REACH 4 – Columbia River Miles 56-70						
W-68.7 (Howard Is.)	200	0	0	20	180	0
W-67.5	8	0	0	0	8	0
O-65.7	73	0	0	0	73	0
O-64.8*	53	0	0	8.2	44.8	0
O-63.5*	45.9	0	0	17.5	28.4	0
W-63.5	13	0	0	0	13	0
W-62.0 (Mt. Solo)	50	25	25	0	0	0
W-59.7 (Hump Island)	69	0	0	7	62	0
O-57.0	51	0	0	0	51	0
REACH 5 – Columbia River Miles 41-56						
Port Westward 1	50	0	0	0	50	0
W-46.3 & W-46.0	72	0	0	0	72	0
W-44.0 (Puget Island)	100	88.2	5.4	2.6	0	3.8
O-42.9	59	0	0	0	59	0
REACH 6 – Columbia River Miles 29-41						
O-38.3 (Tenasillahe Island)	42	0	0	0	42	0
O-34.0 (Welch Island)	42	0	0	0	42	0
REACH 7 – Columbia River Miles 3-29						
O-27.2 - Pillar Rock Island	55.6	0	0	0	55.6	0
O-23.5 - Miller Sands Spit	151	0	0	0	151	0
W-21.0 - Rice Island	228	0	0	0	228	0
Totals	2128.3	209.2	30.4	67.9	1627	198.8

3.1. Interagency Wildlife Mitigation Team

Geoff Dorsey	U. S. Army Corps of Engineers
Kathi Larson	U. S. Fish and Wildlife Service
Alan Clark	U. S. Fish and Wildlife Service
Curt Leigh	Washington Department of Fish and Wildlife
Laurie Vigue	Washington Department of Fish and Wildlife
Ken Mohoric	Washington Department of Fish and Wildlife
Perry Lund	Washington Department of Ecology
Greg Robart	Oregon Department of Fish and Wildlife
Tom Thornton	Oregon Department of Fish and Wildlife
Rollie Montaigne	Port of Portland

The Corps' Project Manager for the Columbia River Channel Deepening Feasibility Study is Laura Hicks.

3.2. Habitat Evaluation Procedures

The U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP) was selected as the analytical means to assess project related wildlife impacts and mitigation attainment levels. The HEP process assesses both habitat quality and quantity for target species selected by the HEP team. HEP considers future conditions for with and without project scenarios to determine the net loss in habitat units, referred to as average annual habitat units. The HEP analysis in this report addresses losses and/or gains associated with use of upland disposal sites and the implementation of mitigation actions over the project life, e.g. 50 years.

3.3. Target Years for HEP Analysis

Five years across the project life were selected as representative periods to analyse project-related habitat impacts:

TY-O 2002
TY-1 2003
TY-5 2007
TY-25 2027
TY-50 2052

The HEP analysis projects impacts across intervening years based upon changes in acreage and HSI values for the target years on either end of each analysis period, e.g., TY0 toTY1, TY-1 toTY-5, TY-5 to TY-25, and TY-25 to TY-50. Target year 0 (TY-0) represents the baseline year prior to project-related impacts. Target year 1 (TY-1) represents the year project-related impacts would occur. Target years 5, 25 and 50 represent points in time where anticipated changes in habitat quality and/or quantity, resulting from land management and/or vegetation succession, are documented. The methodology is applied to both disposal and mitigation sites.

Disposal actions were assumed to result in loss of wildlife habitat in the first year of project implementation, e.g., 2003, although at W-96.5, loss of habitat due to disposal would have occurred three years post-project implementation (Table 2). The assumption that impacts occurred in the first year of construction was intended to simplify the analysis.

Subsequent to the completion of the HEP analysis, Portland District shifted the construction period from 2003-2004 to 2002-2003. The navigation channel downstream of CRM 78 would be dredged in 2002; upstream dredging actions would occur in 2003. The HEP analysis was completed under the assumption that all project impacts would occur in 2003, although W-96.5 would not be impacted until 2006 in the Government Plan (Table 4). A review of those disposal sites downstream of CRM 78 (Tables 4 and 5) indicated that a one year advancement in implementation would have no affect on estimated successional rates or habitat acreage. Thus, the HEP analysis based upon project implementation in 2003 correctly reflects project-related impacts.

3.4. Target Species

Target species (Table 6 and 7) are selected as representative members of the habitats present in the area of impact. Habitat specific models for target species (Table 6), selected by the interagency team were utilized to document wildlife responses to project-related actions. Habitat variables important to each species, methods to measure these variables, and tables and/or figures which assign suitability indices (numerical scores) to habitat variables are identified in these models. Existing HEP models were generally used in this process, modified by the interagency team where necessary, along with development of one new model. All species models used in this analysis are attached in Exhibit A.

The pond-breeding amphibian model is representative of the quality and quantity of wetland habitat and associated (i.e., within 200 meters of a wetland) agricultural and riparian habitats. Canada geese represent an important regional population of several subspecies which winter in the study area and are recreationally important. Two subspecies of Canada geese, dusky and cackling, are the focus of population recovery efforts. Agricultural lands represent important wintering habitat for Canada geese. Mallards represent another important recreationally harvested species which are dependent upon wetland and agricultural lands for habitat. . Savannah sparrows represent grassland/early successional stage grass/forb communities. Yellow warblers are indicative of riparian forest, particularly early seral stages. Cooper's hawks are representative of mature riparian forest habitat. Mink were selected to represent wetland and riparian habitat requirements. Black-capped chickadees are representative of riparian forest conditions that contain cavity bearing trees and or snags. Song sparrows are an edge species which frequent riparian and wetland habitats.

Table 6. HEP Evaluation Species and Habitat Models.

Amphibian Model	WDFW Draft Habitat Suitability Index Model; May 1997
Canada Goose (wintering)	Interagency Wildlife Mitigation Team Habitat Suitability Index Model; May 1997
Mallard	Interagency Wildlife Mitigation Team Habitat Suitability Index Model; May 1997
Savannah Sparrow	Draft Habitat Suitability Index Model; June 1978
Black-capped Chickadee	USFWS Habitat Suitability Index Model; April 1983
Yellow Warbler	USFWS Habitat Suitability Index Model; July 1982
Cooper's Hawk	Review Copy Habitat Suitability Index Model; June 1980
Mink	USFWS Habitat Suitability Index Model; November 1986
Song Sparrow	Draft Habitat Suitability Index Model; June 1978

Table 7. Evaluation species selected by the HEP team and their habitat association.

	HABITAT ASSOCIATION		
SPECIES	RIPARIAN	AGRICULTURE	WETLAND
Amphibian (pond-breeding)	X	X	X
Canada Goose		X	X
Mallard	X	X	X
Savannah Sparrow		X	
Black-capped Chickadee	X		
Yellow Warbler	X		
Cooper's Hawk	X		
Mink	X		X
Song Sparrow	X		X

3.5. Habitat Variables, Field Data Collection Techniques for Habitat Variables, and Habitat Suitability Indices Equations

Each of the nine species considered in the HEP process has a distinct set of habitat variables that represent key habitat features for that species (Tables 8-16). These habitat features, in conjunction with suitability indices from the species models, provide a means to evaluate the quality of the habitat available for a particular species. A variety of field data collection techniques were employed to measure these variables. Certain variables were estimated based upon site visits and aerial photo interpretations. Equations for determination of habitat suitability indices for each species on a habitat specific basis are also presented in Tables 8-16.

Table 8. Habitat variables, their measurement techniques, and equations for habitat suitability determination for pond-breeding amphibians.

Agriculture Reproductive HSI = $(V1*V2*V3*V4)^{0.25}$ Cover HSI = $(V5*V6)^{0.5}$ Associated Habitats HSI = $((\text{min:reprod/cover})*V7)^{0.5}$			
Riparian Water/Reproductive HSI = $(V1*V2*V3*V4)^{0.25}$ Cover HSI = $(V5*V6)^{0.5}$ Associated Habitats HSI = $(\text{Reprod SI}*V7)^{0.5}$			
Wetland Reproductive HSI = $(V1*V2*V3*V4)^{0.25}$ Cover HSI = $(V5*V6)^{0.5}$ Associated Habitats HSI = $(\text{min of reprod/cover}*V7)^{0.5}$			
Variable #	Variable Name	Variable Definition	Field MeasurementTechnique
1	Max of Water Permanence (months)	Water Permanence (Consecutive Months)	Field Observation in conjunction with aerial photograph
2	Max of Percent Area with Permanent Water	Percent of area with permanent water present	Field Observation in conjunction with aerial photograph
3	Max of Water Current	Water current	Field Observation
4	Average of Percent Area Covered by Water (4-40") Dec-Mar	Percent area covered by water 4-40" deep January-March	Field Observation in conjunction with aerial photograph
5	Average of Percent Area Floating Aquatics, Emergents, Wood	Percent submerged, emergent and woody vegetation	Field Observation in conjunction with aerial photograph
6	Average of Percent Ground Cover Along Water's Edge	Percent ground cover along water's edge	0.25 m^2 Quadrat
7	Average of Associated Habitats	Land Use (within 200 m Water Source)	Field Observation in conjunction with aerial photograph

Table 9. Habitat variables, their measurement techniques, and equations for habitat suitability determination for Canada geese.

Agriculture Final HSI = (V1+V2+V3+V4)/4			
Wetland Final HSI = (V1+V2+V3+V4)/4			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Max of Agricultural Crop/Habitat (wintering)	Fallow Ground (fall tilled); Harvested Corn; Cereal Grain (stubble); Cereal Grain (growing); Old Field (weedy grass/forb cover); Pasture; Alfalfa; Wetland (grazed); Wetland (ungrazed); Flooded Riparian	Site observation; Aerial photo; HEP Team Assumption
2	Max of Field Size	Size classes are: < 5 acres; 5-10 acres; 11-25 acres; 26-50 acres; 51-75 acres; and 76-100+ acres	Cartography
3	Max of Disturbance (Depredation)	High Disturbance; Medium Disturbance; Low Disturbance	HEP Team Assumption
4	Max of Winter Grass Height	Height of grass/forage in agricultural crop/habitat used by wintering Canada geese: ~1-6 inches; 6.1-12 inches; 12.1-16 inches; and > 16 inches	Tape measure/Meter Stick

Table 10. Habitat variables, their measurement techniques, and equations for habitat suitability determination for mallard.

Agriculture Nesting SI = (V3+V4+V5)/3 Wintering SI = (V9) Final HSI = (Nesting+2*Wintering)/3			
Riparian Nesting HSI = (V3+V4+V5)/3			
Wetland Nesting SI = (V3+V4+V5)/3 Brood Habitat SI = (V6+V7+V8)/3 Winter Habitat SI = (V9) Final HSI = (Nesting+Brood+2*Winter)/4			
Variable #	Variable Name	Variable Definition	Measurement Technique
3	Average of distance between nest and water with emergent vegetation (miles).	Distance from nesting habitat that occurs in upland situations - agriculture or riparian habitat to body of water with emergent vegetation.	Estimate from aerial photos or site visit.
4	Average of height of nesting cover (inches).	Height of nesting cover in upland situations - agriculture or riparian habitat.	Measuring Tape/Meter Stick
5	Average of percent herbaceous canopy cover	Percent canopy coverage of herbaceous vegetation in nesting habitat.	0.25 m^2 Quadrat
6	Average of Vegetation height in wetlands (inches).	Height of herbaceous vegetation in wetland habitat that represents brood hiding/escape cover.	Measuring Tape/Meter Stick
7	Average Vegetation: open water	The ratio of herbaceous cover to open water in wetland habitat.	Line intercept
8	Area Wetland (acres) less than or equal to two feet in depth.	Area of wetland habitat (acres) that is less than or equal to two feet in depth.	Site observation; Aerial photo
9	Max of Agricultural Crop/Habitat (winter)	Fallow Ground (fall tilled); Harvested Corn; Cereal Grain (stubble); Cereal Grain (growing); Old Field (weedy grass/forb cover); Pasture; Alfalfa; Wetland (grazed); Wetland (ungrazed); Flooded Riparian	Site observation; Aerial photo; HEP Team Assumption

Table 11. Habitat variables, their measurement techniques, and equations for habitat suitability determination for savannah sparrow.

Agriculture Reproductive Value HSI = ((V1+V2+V3+V4+V7)/5)*((V5+V6)$^{0.5}$)/2 Final HSI = (Reproductive Value)			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Average of Litter Depth (in.)	Inches	Tape Measure/Meter Stick
2	Average of Percent of Ground Covered by Litter.	Percent	0.25 m^2 Quadrat
3	Average of Forb Height (in.)	Inches	Tape Measure/Meter Stick
4	Average of Percent Forb Cover	Percent	0.25 m^2 Quadrat
5	Average of Percent Grass Cover	Percent	0.25 m^2 Quadrat
6	Max of Relative Shrub/ Tree Density	A-Trees or shrubs prevalent throughout sample site. B-Widely scattered trees or shrubs throughout sample site (Savannah). C-No trees or tall shrubs present, a few low shrubs scattered throughout sample site. D-No trees or shrubs present	Field Observation
7	Average of Average Height of Grasses.	Inches	Tape Measure/Meter Stick

Table 12. Habitat variables, their measurement techniques, and equations for habitat suitability determination for black-capped chickadee.

Riparian Food HSI = $(V1*V2)^{0.5}$ Reproduction HSI = (V4) Final HSI = (min of Food and Reproduction HSI)			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Sum of Corrected Tree Cover (dm)	Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies af all woody vegetation taller than 5.0 m (16.5 ft)].	Line Intercept
2	Average of Tree height (ft.)	Average height of overstory trees (the average height from the ground surface to the top of those trees which are ò 80 percent of the height of the tallest tree in the stand).	Clinometer; calculate or equal method
3	Tree canopy volume/area of ground surface	Tree canopy volume/area of the ground surface (the sum of the volume of the canopies of each tree sampled divided by the total area sampled).	Species model gave choice of using V3 or V1 and V2. V1 and V2 were selected for use as they were easier to measure in the field. V3 was not measured.
4	Sum of Corrected Number of Snags 10 to 25 cm dbh/0.4 ha (4 to 10 inches dbh/1.0 acre).	Number of snags 10 to 25 cm dbh/0.4 ha (4 to 10 inches dbh/1.0 acre) [the number of standing dead trees or partly dead trees in the size class indicated that are at least 1.8 m (6 ft) tall. Trees in which at least 50% of the branches have fallen, or are present but no longer bear foliage, are to be considered snags]	Belt transect; calculate

Table 13. Habitat variables, their measurement techniques, and equations for habitat suitability determination for yellow warbler.

Riparian Reproduction HSI = $(V1*V2*V3)^{0.33}$			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Sum of Corrected Shrub Cover (dm)	Percent deciduous shrub crown cover (the percent of the ground that is shaded by a vertical projection of the canopies of woody deciduous vegetation which are less than 5 m (16.5 ft) in height).	Line Intercept
2	Average of Average Height Deciduous Shrub Canopy.	Average height of deciduous shrub canopy (the average height from the ground surface to the top of those shrubs which comprise the uppermost shrub canopy).	Measuring Tape/Meter Stick
3	Percent Shrub Cover Composed of Hydrophytic Species (dm).	Percent of deciduous shrub canopy comprised of hydrophytic shrubs (the relative percent of the amount of hydrophytic shrubs compared to all shrubs, based on canopy cover).	Line Intercept

Table 14. Habitat variables, their measurement techniques, and equations for habitat suitability determination for Cooper's hawk.

Riparian Cover and Reproductive HSI = $(V1*V2)^{0.5}$			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Sum of Corrected Tree Cover (dm)	Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies af all woody vegetation taller than 5.0 m (16.5 ft)].	Line Intercept
2	Max of Forest Overstory Size Class	A-Saplings (< 15 cm (6 in) dbh); B-Pole timber (> 15 cm (6 in) to 25 cm (10 in) dbh); C-Sawtimber (> 25 cm (10 in) to 50 cm (20 in) in dbh); and D-Mature trees (> 50 cm (20 in) dbh).	Field Observation
3*	Percent canopy closure of evergreen trees.	Percent of canopy closure attributable to evergreen trees.	Evergreen trees (V3) were not encountered in sampled areas. V3 was not used in model.

* Variable 3 was not carried forth in the analysis as riparian habitat in the project impact area (disposal and mitigation) did not contain an evergreen component. The lack of evergreen trees in riparian stands along the Columbia River was not considered detrimental to habitation of these stands by Cooper's hawk.

Table 15. Habitat variables, their measurement techniques, and equations for habitat suitability determination for mink.

Riparian Water HSI = (V1) Cover HSI = ((min:1;V2+V3+V4) +V5)/2 Final HSI = (min of Water and Cover)			
Wetland Water HSI = (V1) Palustrine emergent wetlands Cover HSI = (4*V4+V5)/5 Final HSI = (minimum of Water and Cover)			
Variable #	Variable Name	Variable Definition	Suggested Technique
1	Average of Percent of Year Water Present	Percent of year with surface water present (the percent of the year in which wetland cover types have surface water present).	Field Observation in conjunction with aerial photograph
2	Sum of Corrected Tree Cover (dm)	Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation taller than 5.0 m (16.5 ft)].	Line Intercept
3	Sum of Corrected Shrub cover (dm)	Percent canopy cover of shrubs (the percent of the ground that is shaded by a vertical projection of the canopies of woody deciduous vegetation which are less than 5 m (16.5 ft) in height).	Line Intercept
4	Average of Percent Canopy Cover of Emergent Herbaceous Vegetation	Percent canopy cover of emergent herbaceous vegetation (the percent of the water surface shaded by a vertical projection of the canopies of emergent herbaceous vegetation, both persistent and nonpersistent).	0.25 m^2 Quadrat
5	Percent Canopy Cover of Trees and Shrubs within 100 m Forest Edge	Percent canopy cover of trees and shrubs within 100 m (328 ft) of the wetlands edge [the percent of the terrestrial ground surface within 100 m (328 ft) of a wetland's edge that is shaded by a vertical projection of the canopies of all woody vegetation].	Line Intercept
6	Average of Percent Shoreline Cover within 1 m of Water's Edge	Percent shoreline cover within 1 m (3.3 ft) of water's edge [An estimate of the vegetative and structural complexity at the land/water interface (<1 m from water's edge). Cover may be provided by overhanging or emergent vegetation, undercut banks, logjam	0.25 m^2 Quadrat

Table 16. Habitat variables, their measurement techniques, and equations for habitat suitability determination for song sparrow.

Riparian Food HSI = (V1) Cover HSI = (V1*V2)0.5 Reproductive HSI = (V1*V4)0.5 Final HSI = (Min: Food;Reprod;Cover)			
Wetland Water Value HSI = (V1) Cover and Reproductive Value HSI = (V2*V3)0.5 Final HSI = (min of Water and Cover/Reprod.)			
Variable #	Variable Name	Variable Definition	Measurement Technique
1	Max of Shrub Distribution	A-No shrubs presentB-Scattered single shrubsC-Scattered groups of shrubsD-Continuous dense shrubby vegetation	Field Observation
2	Sum of Corrected Tree Cover (dm)	Percent tree canopy closure [the percent of the ground surface that is shaded by a vertical projection of the canopies of all woody vegetation taller than 5.0 m (16.5 ft)].	Line Intercept
3	Average of Height of Lower Shrub Canopy (ft.)	Inches	Tape Measure/Meter Stick
4	Max of Song Perch Site Availability	A-Shrub canopy height homogenous. No trees or other perching objects available just above general shrub layerB-Shrub canopy height somewhat heterogeneous. A few shrubs small trees, or other perching objects available just above	Field Observation

3.6. Habitat Types and Definitions

Three basic habitat types, e.g., riparian, agricultural and wetland were initially considered for analysis of disposal and mitigation site impacts from project-related actions (Tables 4 and 5). These habitat types were subsequently broken into a total of 15 habitat types to account for target species model considerations and physical characteristics (Table 17). Habitat delineation's were based upon field observation, aerial photography (1996) interpretation and a review of soil types, National Wetland Inventory and Bi-State maps. Emphasis for habitat mapping was placed upon field observations and aerial photography interpretation.

Table 17. Habitat types for HEP analysis of disposal and mitigation sites.

HABITAT	DESCRIPTION
Wetland	Wetland plant composition, structure and hydrology, undrained, minimal or no grazing, no tillage
Wetland - Farmed	Agricultural cropland with some wetland characteristics, minimal wetland plant composition, structure or hydrology, drained, grazed and/or tilled and cropped
Intertidal Emergent Wet.	Intertidal with emergent marsh or potential for emergent marsh establishment with management
Riparian	Riparian forest plant composition and structure, ungrazed or degraded
Riparian - Degraded	Riparian forest with understory vegetation and tree recruitment significantly compromised by grazing or dense stands of blackberries
Riparian Early Success.	Early successional riparian forest trees pioneering onto a site
Rip. Assoc. Hab. - Degrad.	As defined for Riparian-Degraded but within 200 meters of a wetland boundary
Riparian Assoc. Hab.	As defined for Riparian but within 200 meters of a wetland boundary
Riparian Assoc. Hab.- E.S.	As defined for Riparian Early Successional but within 200 meters of a wetland boundary
Ag. Cropland	Agricultural cropland, either in row crops, cereal grains or pasture
Assoc. Hab. - Ag. Crop.	As defined for Agricultural Cropland, but within 200 meters of a wetland boundary
Assoc. Hab. - Ag. Crop. - Degraded	As defined for Assoc. Habitat Agricul. Cropland but cropland (typically pastureland) overtaken with blackberry thickets
Ag. Cropland - Degraded - Blackberry thickets	As defined for Assoc. Habitat Agricul. Cropland – degraded, but cropland not within 200 meters of a wetland boundary
Other (beaches, water)	Beaches, open water, houses, developed land with structures present, etc; land with no wildlife habitat value and/or not impacted by disposal or mitigation actions

3.7. Habitat Mapping

Base condition and post-implementation maps were prepared for all dredged material disposal sites (Exhibit B) where habitat impacts were forecast. Some pre-existing dredged material disposal sites that are slated for disposal use under the without project condition and that do not contain wetland or riparian habitat were not habitat mapped. Base condition and post-implementation habitat maps were also prepared for mitigation sites (Exhibit C). Habitat boundaries were based upon aerial photograph interpretation (1996 color infrared at 1:24,000 scale), field observation and a forecast of future habitat conditions with implementation of disposal and mitigation actions. Detailed surveys to exactly determine habitat boundaries based upon plant community composition, elevation and/or other physical factors were not implemented during this phase of the planning process. Such detailed surveys would be conducted, to the extent practicable, during the subsequent pre-construction, engineering and design (PED) phase of the project. Specific site selection for either disposal and/or mitigation purposes will be substantially firmer in detail during PED than during the current feasibility planning phase.

Habitat maps, prepared for each disposal and mitigation site considered in detail during the feasibility planning phase, were scaled at 1:24,000 in order to match with the 1996 aerial photography. Habitat polygons mapped corresponded with the habitat classifications identified in Table 17. Acreage for each habitat polygon at each site was determined in order to address baseline conditions and impacts from either disposal and/or mitigation actions. Habitat maps for the with and without project condition for disposal and mitigation sites are located in Exhibits B and C, respectively.

Future with and without project conditions for each disposal and mitigation site are provided in Exhibits D and E, respectively. These forecasted conditions represent an estimate of future conditions at the site for the with and without project scenarios. Various factors are taken into account including land use zoning, dredged material disposal and proposed habitat management measures at mitigation sites.

Two dredged material disposal plans were evaluated in the study (Tables 1). Habitat acreage for each disposal plan and disposal location, for the with and without project condition, was then estimated for the target years (0, 1, 5, 25 and 50) used in the HEP process (Tables 18 and 19).

Table 18. Habitat acreage for with and without project condition and target year for Government Disposal Plan sites.

TARGET YEAR – 0 (2002)										
Disposal Site	Assoc. Hab. Ag.	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Rip. Assoc. Hab. E.S.	Rip. Assoc. Habitat	Rip. Assoc. Hab. Deg.	Wetland	Farmed Wetland
Sauvie 1										
W/out proj.	16.8	31.2	0	0	0	0	0	0	0	0
With proj	16.8	31.2	0	0	0	0	0	0	0	0
W-96.9										
W/out proj.	8.2	0	0	0	0	0	0	0	0	0
With proj	8.2	0	0	0	0	0	0	0	0	0
W-96.5										
W/out proj.	25	0	0	0	0	0	0	0	0	0
With proj	25	0	0	0	0	0	0	0	0	0
W-95.7										
W/out proj.	6.9	16.5	0	0	0	0	0	0	0	1.6
With proj	6.9	16.5	0	0	0	0	0	0	0	1.6
Scappoose D.										
W/out proj.	75.8	0	0	0	0	0	0	0	7.7	23.5
With proj	75.8	0	0	0	0	0	0	0	7.7	23.5
Austin Pt.										
W/out proj.	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	2.7	0	0	0	0	0	0
W-82.0										
W/out proj.	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	2.9	0	0
Martin Is.										
W/out proj.	10.5	69.2	0	0	0	0	0	0.3	0	0
With proj	10.5	69.2	0	0	0	0	0	0.3	0	0
O-77.0										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj.	0	0	0	0	5	0	0	0	0	0
With proj	0	0	0	0	5	0	0	0	0	0
W-68.7										
W/out proj.	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	20	0	0	0	0	0
O-64.8										
W/out proj.	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	8.2	0	0	0	0	0	0	0
O-63.5										
W/out proj.	0	0	17.5	0	0	0	0	0	0	0
With proj	0	0	17.5	0	0	0	0	0	0	0
W-62.0										
W/out proj.	25	0	0	0	0	0	0	0	25	0
With proj	25	0	0	0	0	0	0	0	25	0
W-59.7										
W/out proj.	0	0	0	0	7	0	0	0	0	0
With proj	0	0	0	0	7	0	0	0	0	0
W-44.0										
W/out proj.	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
TOTAL										
W/out proj.	206.3	167	25.7	5.3	32	0	0	3.2	38.1	25.1
With proj	206.3	167	25.7	5.3	32	0	0	3.2	38.1	25.1

Table 18. Habitat acreage for with and without project condition and target year for Government Disposal Plan sites. (Continued)

TY-1 (2003)										
Disposal Site	Assoc. Hab. Ag.	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Rip. Assoc. Hab. E.S.	Rip. Assoc. Habitat	Rip. Assoc. Hab. Deg.	Wetland	Farmed Wetland
Sauvie 1										
W/out proj.	16.8	31.2	.0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.9										
W/out proj.	8.2	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.5										
W/out proj.	25	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-95.7										
W/out proj.	6.9	16.5	0	0	0	0	0	0	0	1.6
With proj	0	0	0	0	0	0	0	0	0	0
Scappoose D.										
W/out proj.	75.8	0	0	0	0	0	0	0	7.7	23.5
With proj	0	0	0	0	0	0	0	0	0	0
Austin Pt.										
W/out proj.	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj.	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Martin Is.										
W/out proj.	10.5	69.2	0	0	0	0	0	0.3	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj.	0	0	0	0	5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj.	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj.	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj.	0	0	17.5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj.	25	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj.	0	0	0	0	7	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj.	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj.	206.3	167	25.7	5.3	32	0	0	3.2	38.1	25.1
With proj	0	0	0	0	0	0	0	0	0	0

Table 18. Habitat acreage for with and without project condition and target year for Government Disposal Plan sites. (Continued)

TY-5 (2007)										
Disposal Site	Assoc. Hab. Ag.	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Rip. Assoc. Hab. E.S.	Rip. Assoc. Habitat	Rip. Assoc. Hab. Deg.	Wetland	Farmed Wetland
Sauvie 1										
W/out proj.	16.8	31.2	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.9										
W/out proj.	8.2	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.5										
W/out proj.	25	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-95.7										
W/out proj.	6.9	16.5	0	0	0	0	0	0	0	1.6
With proj	0	0	0	0	0	0	0	0	0	0
Scappoose D.										
W/out proj.	75.8	0	0	0	0	0	0	0	7.7	23.5
With proj	0	0	0	0	0	0	0	0	0	0
Austin Pt.										
W/out proj.	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj.	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Martin Is.										
W/out proj.	10.5	69.2	0	0	0	0	0	0.3	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj.	0	0	0	0	0	6	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj.	0	0	0	0	10	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj.	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj.	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj.	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj.	25	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj.	0	0	0	0	10	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj.	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj.	206.3	167	25.7	5.3	43.5	6	0	3.2	38.1	25.1
With proj	0	0	0	0	0	0	0	0	0	0

Table 18. Habitat acreage for with and without project condition and target year for Government Disposal Plan sites. (Continued)

TY-25 (2027)										
Disposal Site	Assoc. Hab. Ag.	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Rip. Assoc. Hab. E.S.	Rip. Assoc. Habitat	Rip. Assoc. Hab. Deg.	Wetland	Farmed Wetland
Sauvie 1										
W/out proj.	16.8	31.2	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.9										
W/out proj.	8.2	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.5										
W/out proj.	25	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-95.7										
W/out proj.	6.9	16.5	0	0	0	0	0	0	0	1.6
With proj	0	0	0	0	0	0	0	0	0	0
Scappoose D.										
W/out proj.	75.8	0	0	0	0	0	0	0	7.7	23.5
With proj	0	0	0	0	0	0	0	0	0	0
Austin Pt.										
W/out proj.	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj.	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Martin Is.										
W/out proj.	10.5	69.2	0	0	0	0	0	0.3	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj.	0	0	0	0	0	18	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj.	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj.	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj.	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj.	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj.	0	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj.	0	0	0	0	25	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj.	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj.	181.3	167	25.7	5.3	68.5	18	0	3.2	38.1	25.1
With proj	0	0	0	0	0	0	0	0	0	0

Table 18. Habitat acreage for with and without project condition and target year for Government Disposal Plan sites. (Continued)

TY-50 (2052)										
Disposal Site	Assoc. Hab. Ag.	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Rip. Assoc. Hab. E.S.	Rip. Assoc. Habitat	Rip. Assoc. Hab. Deg.	Wetland	Farmed Wetland
Sauvie 1										
W/out proj.	16.8	31.2	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.9										
W/out proj.	8.2	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-96.5										
W/out proj.	25	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-95.7										
W/out proj.	6.9	16.5	0	0	0	0	0	0	0	1.6
With proj	0	0	0	0	0	0	0	0	0	0
Scappoose D.										
W/out proj.	75.8	0	0	0	0	0	0	0	7.7	23.5
With proj	0	0	0	0	0	0	0	0	0	0
Austin Pt.										
W/out proj.	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj.	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Martin Is.										
W/out proj.	10.5	69.2	0	0	0	0	0	0.3	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj.	0	0	0	0	0	18	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj.	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj.	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj.	0	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj.	0	0	0	0	55	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj.	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj.	181.3	167	25.7	5.3	58.5	18	0	3.2	38.1	25.1
With proj	0	0	0	0	0	0	0	0	0	0

Table 19. Habitat acreage by site, with and without project condition, and target year for proposed disposal sites that require mitigation, Sponsor Disposal Plan.

TY-0 (2002)										
Disposal Sites	Assoc. Habitat Agriculture	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Riparian Assoc. Habitat Early Succ.	Riparian Assoc. Habitat	Riparian Assoc. Habitat Degraded	Wetland	Farmed Wetland
Gateway 3										
W/out proj.	61.2	15.3	0	0	0	0	0	0	0	0
With proj	61.2	15.3	0	0	0	0	0	0	0	0
Austin Point										
W/out proj	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	2.7	0	0	0	0	0	0
Lonestar										
W/out proj	3	0	2	0	0	0	0	0	0	0
With proj	3	0	2	0	0	0	0	0	0	0
W-82.0										
W/out proj	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	2.9	0	0
Morse Bro.										
W/out proj	0	0	5	0	0	0	0	0	0	0
With proj	0	0	5	0	0	0	0	0	0	0
O-77.0										
W/out proj	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj	0	0	0	0	5	0	0	0	0	0
With proj	0	0	0	0	5	0	0	0	0	0
W-68.7										
W/out proj	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	20	0	0	0	0	0
O-64.8										
W/out proj	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	8.2	0	0	0	0	0	0	0
O-63.5										
W/out proj	0	0	17.5	0	0	0	0	0	0	0
With proj	0	0	17.5	0	0	0	0	0	0	0
W-62.0										
W/out proj	25	0	0	0	0	0	0	0	25	0
With proj	25	0	0	0	0	0	0	0	25	0
W-59.7										
W/out proj	0	0	0	0	7	0	0	0	0	0
With proj	0	0	0	0	7	0	0	0	0	0
W-44.0										
W/out proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
TOTAL										
W/out proj	124.3	65.4	30.7	5.3	32	0	0	2.9	30.4	0
With proj	124.3	65.4	30.7	5.3	32	0	0	2.9	30.4	0

Table 19. Habitat acreage by site, with and without project condition, and target year for proposed disposal sites that require mitigation, Sponsor Disposal Plan. (Continued)

TY-1 (2003)										
Disposal Sites	Assoc. Habitat Agriculture	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Riparian Assoc. Habitat Early Succ.	Riparian Assoc. Habitat	Riparian Assoc. Habitat Degraded	Wetland	Farmed Wetland
Gateway 3										
W/out proj.	56.8	14.2	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Austin Point										
W/out proj	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Lonestar										
W/out proj	3	0	2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Morse Bro.										
W/out proj	0	0	5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj	0	0	0	0	5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj	0	0	17.5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj	25	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj	0	0	0	0	7	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj	119.9	64.3	30.7	5.3	32	0	0	2.9	30.4	0
With proj	0	0	0	0	0	0	0	0	0	0

Table 19. Habitat acreage by site, with and without project condition, and target year for proposed disposal sites that require mitigation, Sponsor Disposal Plan. (Continued)

TY-5 (2005)										
Disposal Sites	Assoc. Habitat Agriculture	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Riparian Assoc. Habitat Early Succ.	Riparian Assoc. Habitat	Riparian Assoc. Habitat Degraded	Wetland	Farmed Wetland
Gateway 3										
W/out proj.	39.2	9.8	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Austin Point										
W/out proj	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Lonestar										
W/out proj	3	0	2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Morse Bro.										
W/out proj	0	0	5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj	0	0	0	0	0	6	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj	0	0	0	0	10	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj	25	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj	0	0	0	0	10	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj	102.3	59.9	30.7	5.3	43.5	6	0	2.9	30.4	0
With proj	0	0	0	0	0	0	0	0	0	0

Table 19. Habitat acreage by site, with and without project condition, and target year for proposed disposal sites that require mitigation, Sponsor Disposal Plan. (Continued)

TY-25 (2027)										
Disposal Sites	Assoc. Habitat Agriculture	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Riparian Assoc. Habitat Early Succ.	Riparian Assoc. Habitat	Riparian Assoc. Habitat Degraded	Wetland	Farmed Wetland
Gateway 3										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Austin Point										
W/out proj	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Lonestar										
W/out proj	3	0	2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Morse Bro.										
W/out proj	0	0	5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj	0	0	0	0	0	18	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj	0	0	0	0	20	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj	0	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj	0	0	0	0	25	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj	38.1	50.1	30.7	5.3	68.5	18	0	2.9	30.4	0
With proj	0	0	0	0	0	0	0	0	0	0

Table 19. Habitat acreage by site, with and without project condition, and target year for proposed disposal sites that require mitigation, Sponsor Disposal Plan. (Continued)

TY-50 (2052)										
Disposal Sites	Assoc. Habitat Agriculture	Ag. Cropland	Riparian	Riparian Degraded	Riparian Early	Riparian Assoc. Habitat Early Succ.	Riparian Assoc. Habitat	Riparian Assoc. Habitat Degraded	Wetland	Farmed Wetland
Gateway 3										
W/out proj.	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Austin Point										
W/out proj	0	0	0	2.7	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Lonestar										
W/out proj	3	0	2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-82.0										
W/out proj	0	0	0	0	0	0	0	2.9	0	0
With proj	0	0	0	0	0	0	0	0	0	0
Morse Bro.										
W/out proj	0	0	5	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-77.0										
W/out proj	0	0	0	0	0	18	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-70.1										
W/out proj	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-68.7										
W/out proj	0	0	0	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-64.8										
W/out proj	0	0	8.2	0	0	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
O-63.5										
W/out proj	0	0	17.5	0	3.5	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-62.0										
W/out proj	0	0	0	0	0	0	0	0	25	0
With proj	0	0	0	0	0	0	0	0	0	0
W-59.7										
W/out proj	0	0	0	0	55	0	0	0	0	0
With proj	0	0	0	0	0	0	0	0	0	0
W-44.0										
W/out proj	38.1	50.1	0	2.6	0	0	0	0	5.4	0
With proj	0	0	0	0	0	0	0	0	0	0
TOTAL										
W/out proj	38.1	50.1	30.7	5.3	58.5	18	0	2.9	30.4	0
With proj	0	0	0	0	0	0	0	0	0	0

3.8. Growth and Successional Rates

Habitat growth and successional rates were taken into account during development of species-specific spreadsheets detailing habitat suitability indices by habitat and target year for the with and without project condition. The application of growth and successional rates for former disposal sites is discussed on a species and habitat basis in the following tables and text.

Table 20 depicts all 15 habitat types considered in this HEP analysis in order to reacquaint the reader with the habitat types considered in this investigation (reference Table 17). Those habitats not used by pond-breeding amphibians have a zero entered as the HSI value (Table 20). All subsequent species tables depicting HSI values only report the habitat that the target species would use. This conformity was enacted to lessen the complexity of the tables. Table 7 depicts the habitats used by each target species.

3.9. Disposal Sites

Pond-breeding Amphibians

HSI values for pond-breeding amphibians are depicted in Table 20. The values assigned for wetland, riparian associated habitat, and associated habitat – agricultural cropland were derived from the species models using field-collected information and estimates for some habitat variables. Wetland-farmed habitat was assigned the same HSI value as associated habitat - agricultural cropland, as habitat conditions were directly comparable to cultivated lands. Riparian associated habitat - degraded was assigned an HSI value one-third that of riparian associated habitat to reflect the lack of understory grass/forb and shrub cover and negligible recruitment of trees into the stand. These conditions are generally attributable to continued and/or intensive livestock grazing in the stand that degrades the habitat condition for wildlife. Riparian early successional habitat was also assigned an HSI value one-third that of riparian habitat to reflect the lack of vegetative structural and species complexity development of early successional stands. Maturation and development of vegetative structural and species complexity for riparian early successional habitat is indicated by increasing the HSI value in target years 25 and 50.

Table 20. HSI values for pond-breeding amphibians by habitat classification by target year for the with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
HABITAT	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Wetland - Farmed	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Intertidal Emergent Wet.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian - Degraded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian-Early Succ.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Hab. - Degrad.	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Riparian Assoc. Hab.	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Riparian Assoc. Hab.-E.S.	0.12	0.12	0.12	0.24	0.36	0.12	0.12	0.12	0.24	0.36
Ag. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assoc. Hab. - Ag. Crop.	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Ag. Cropland - Degraded - Blackberry thickets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dredged Material	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Canada Geese

HSI values for Canada geese are depicted in Table 21. The values assigned for wetland and agricultural cropland were derived from the species models using field-collected information and estimates for some habitat variables. Wetland-farmed and associated habitat - agricultural cropland habitats were assigned the same HSI value as agricultural cropland as habitat conditions were directly comparable, i.e. these habitat types are all cultivated lands.

Table 21. HSI values for Canada geese by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Wetland - Farmed	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Intertidal Emergent Wet.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Ag. Cropland	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop.	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68

Mallard

HSI values for mallard are depicted in Table 22. The values assigned for wetland, riparian and agricultural cropland were derived from the species models using field-collected information and estimates for some habitat variables. Wetland-farmed and associated habitat - agricultural cropland habitats were assigned the same HSI value as agricultural cropland as habitat conditions

were directly comparable, i.e., all types are cultivated lands. Similarly, riparian associated habitat was assigned the same habitat value as riparian habitat. Intertidal emergent wetland habitat was assigned a value of 1.0 given the extensive winter use that mallards make of this habitat. Riparian degraded and riparian associated habitat – degraded were assigned HSI values one-third that of riparian habitat to reflect the lack of understory grass/forb and shrub cover and negligible recruitment of trees into the stand. These conditions are generally attributable to continued and/or intensive livestock grazing in the stand that degrades the habitat condition for wildlife. Riparian and riparian associated habitat - early successional habitats were also initially assigned an HSI value one-third that of riparian habitat to reflect the lack of vegetative structural and species complexity development of early successional stands. Maturation and development of vegetative structural and species complexity for riparian early successional habitat is indicated by increasing the HSI value in target years 5, 25 and 50. The HSI value for agricultural cropland – degraded habitat reflects the value assigned to agricultural (pasture) lands overtaken by monotypic stands of exotic blackberries.

Table 22. HSI values for mallard by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Intertidal Emergent Wet.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Riparian	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian - Degraded	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian-Early Succ.	0.21	0.21	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Riparian Assoc. Hab. - Degrad.	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian Assoc. Hab.	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian Assoc. Hab.-E.S.	0.21	0.21	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Ag. Cropland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Ag. Cropland - Degraded - Blackberry thickets	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Savannah Sparrow

HSI values for savannah sparrows are depicted in Table 23. The values assigned for agricultural cropland were derived from the species models using field-collected information and estimates for some habitat variables. Wetland-farmed and associated habitat - agricultural cropland habitats were assigned the same HSI value as agricultural cropland as habitat conditions were directly comparable, i.e., these habitat types are all cultivated lands. Agricultural cropland – degraded was assigned a value one-third that of agricultural cropland. The lesser value for degraded cropland is intended to reflect the negative influence of blackberry thickets on savannah sparrow habitat.

Table 23. HSI values for savannah sparrow by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland - Farmed	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Ag. Cropland	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop.	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Ag. Cropland - Degraded - Blackberry thickets	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

Black-capped Chickadee

HSI values for black-capped chickadees are depicted in Table 24. The values assigned for riparian habitat were derived from the species models using field-collected information and estimates for some habitat variables. Riparian associated habitat was assigned the same HSI value as riparian habitat as habitat conditions were directly comparable. Riparian degraded and riparian associated habitat – degraded were each assigned HSI values one-third that of riparian habitat to reflect the lack of understory grass/forb and shrub cover and negligible recruitment of trees into the stand. These conditions are generally attributable to continued and/or intensive livestock grazing in the stand that degrades the habitat condition for wildlife. Riparian and riparian associated habitat - early successional habitats were also initially assigned an HSI value one-third that of riparian habitat to reflect the lack of vegetative structural and species complexity development of early successional stands. Maturation and development of vegetative structural and species complexity for riparian early successional habitat is indicated by increasing the HSI value in target years 25 and 50

Table 24. HSI values for black-capped chickadees by habitat classification by target year for with and without project conditions – disposal site analysis.

	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian - Degraded	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian-Early Succ.	0.15	0.15	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44
Riparian Assoc. Hab. - Degrad.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian Assoc. Hab.	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian Assoc. Hab.-E.S.	0.15	0.15	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44

Yellow Warbler

HSI values for yellow warblers are depicted in Table 25. The values assigned for riparian habitat were derived from the species models using field-collected information and estimates for some habitat variables. The rationale for assignment of HSI values across target years for yellow warblers is as described for black-capped chickadees.

Table 25. HSI values for yellow warblers by habitat classification by target year for with and without project conditions – disposal site analysis.

	With Project					Without Project				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.-E.S.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40

Cooper's Hawk

HSI values for Cooper's hawks are depicted in Table 26. The values assigned for riparian habitat were derived from the species models using field-collected information and estimates for some habitat variables. The rationale for assignment of HSI values across target years for Cooper's hawk are as described for black-capped chickadee.

Table 26. HSI values for Cooper's hawk by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian - Degraded	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian-Early Succ.	0.26	0.26	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77
Riparian Assoc. Hab. - Degrad.	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian Assoc. Hab.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian Assoc. Hab.-E.S.	0.26	0.26	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77

Mink

HSI values for mink are depicted in Table 27. The values assigned for riparian habitat were derived from the species models using field-collected information and estimates for some habitat variables. The rationale for assignment of HSI values for riparian habitats across target years for mink are comparable to those described for black-capped chickadee. Wetland habitat HSI values reflect measured values for wetland habitat and are indicative of tall, dense grass-forb cover with an intermixture of shrubs. Wetland-farmed habitat was assigned a zero value for mink as grazing and/or tillage practices precluded shrub and tall, dense grass-forb development.

Table 27. HSI values for mink by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian - Degraded	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian-Early Succ.	0.22	0.22	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67
Riparian Assoc. Hab. - Degrad.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian Assoc. Hab.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian Assoc. Hab.-E.S.	0.22	0.22	0.22	0.45	0.67	0.22	0.22	0.22	0.45	0.67
Wetland	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Song Sparrow

HSI values for song sparrows are depicted in Table 28. The values assigned for riparian habitat were derived from the species models using field-collected information and estimates for some habitat variables. The rationale for assignment of HSI values for riparian habitats across target years for song sparrows are as described for black-capped chickadee. Wetland habitat HSI values reflect measured values for wetland habitat and are indicative of tall, dense grass-forb cover with an intermixture of shrubs. Wetland-farmed habitat was assigned a zero value for song sparrows as grazing and/or tillage practices precluded shrub and tall, dense grass-forb development.

Table 28. HSI values for song sparrow by habitat classification by target year for with and without project conditions – disposal site analysis.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.-E.S.	0.13	0.13	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Wetland	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Wetland - Farmed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

4. HEP ANALYSIS

4.1. HEP Assumptions

1. The year 1997 will be used as the base year for determining acreage of various habitats projected to occur at proposed disposal and mitigation sites. The analysis of habitats impacted will include riparian habitat projected to occur during the project life (50-year period) at some previously used dredged material disposal locations. Previously used disposal sites (Government and/or Sponsor Plan) assessed for riparian habitat present or that will develop include W-86.5 (Austin Pt.), W-82.0, O-77.0, W-70.1, W-68.7, O-64.8, O-63.5, and W-59.7. The riparian habitat at these locations lies within the established footprint for these disposal sites (Exhibit B).

2. Disposal actions were assumed to result in the complete loss of wildlife habitat in the first year of project implementation, e.g., 2003, although at W-96.5, loss of habitat due to disposal would have occurred three years post-project implementation (Table 2). The assumption that impacts occurred in the first year of construction was intended to simplify the analysis. The fact that impacts occur in the first year also represents the worst-case scenario.

Subsequent to the completion of the HEP analysis, Portland District shifted the construction period from 2003-2004 to 2002-2003. The navigation channel downstream of CRM 78 would be dredged in 2002; upstream dredging actions would occur in 2003. The HEP analysis was completed under the assumption that all project impacts would occur in 2003, although W-96.5 would not be impacted until 2006 in the Government Plan (Table 4). A review of those disposal sites downstream of CRM 78 (Tables 4 and 5) indicated that a one year advancement in implementation would have no affect on estimated successional rates or habitat acreage. Thus, the HEP analysis was based upon project implementation in 2003 correctly and reflects project-related impacts.

3. The without and with project conditions for disposal site development have been provided to the Interagency Wildlife Mitigation Team. They will be used as currently written.

4.2. HEP Analysis Methodology

The HEP analysis was accomplished through use of Excel software. The analysis was conducted by EDAW, Inc., 1505 Western Avenue, Suite 601, Seattle, Washington 98101. That firm collected field data under contract with Portland District for determination of habitat suitability indices. Portland District determined some information, such as distance to water, from aerial photo interpretation or estimates based on field observations. Habitat suitability indices were calculated for each species by EDAW, Inc. using the HEP models and associated formulas selected and/or adapted by the Interagency Team. Portland District then developed spreadsheets (Tables 20-28) which identified and projected HSI values across target years for each species by habitat at both disposal and mitigation sites. Excel spreadsheets detailing habitat acreage across target years for each disposal site (Tables 18 and 19) were also compiled. EDAW, Inc. then utilized the HSI and acreage spreadsheets to calculate average annual habitat units (AAHUs).

Project-related losses were measured on the basis of AAHUs lost. The loss in AAHUs was determined for both the Government and Sponsor's Disposal Plans (Tables 18 and 19).

The calculated losses in AAHUs were summed across all 16 disposal sites by target species for both disposal plans. This provided a cumulative loss total on an individual species basis, and by addition of each species' losses, a cumulative loss total for each disposal action. An identical process was used to determine individual and cumulative species gains or losses, and cumulative net gain, in AAHUs for individual and groups of mitigation sites.

The AAHUs calculated through the HEP process for wetland and riparian habitats at both disposal and mitigation locations were mathematically adjusted so the results were comparable across all three major habitat categories. The adjustment was predicated upon the unequal number of target species used to measure habitat losses or gains for each major habitat category. Four target species represented agricultural habitat, whereas wetland and riparian habitat were represented by 5 and 7 species. Consequently, total losses in AAHUs for disposal sites accumulate more rapidly for wetland and riparian habitat than for agricultural habitat. Similarly, total gains in AAHUs for mitigation sites accumulate more rapidly for wetland and riparian habitat than for agricultural habitat given a disparate number of representative species per habitat.

Initial results from the CRCD mitigation evaluation indicated that site acreage required for mitigation was comparable to acreage lost due to disposal actions. This was considered atypical as such a situation would require implementation of mitigation actions on lands with low HSI values and attainment, through management, of high HSI values on those same lands. Observation indicated that only modest gains in HSI values were anticipated for mitigation lands. Analysis indicated that the problem arose from the disparate number of target species by major habitat category. Disposal site impacts principally occur on agricultural lands, thus losses are based upon the cumulative losses for the four target species. The proposed mitigation actions emphasize riparian and wetland habitat development and cumulative gains are based upon 7 and 5 target species. Without an adjustment to the AAHU calculations, the analysis would give a false impression of mitigation requirements. Thus the adoption of a mathematical adjustment to provide for a level playing field across the different habitat categories for both the disposal and mitigation analyses.

To remedy the situation, wetland and riparian AAHU results for disposal and mitigation sites were adjusted to be comparable to those calculated for agricultural habitats. Wetland AAHU values were multiplied by 0.8; riparian AAHU values were multiplied by 0.57.

4.3. HEP Analysis – Project Related Losses

HEP analysis was not conducted for the No Action and Non-Structural Alternatives. The No Action alternative represents the existing condition, i.e., the Dredged Material Management Plan. The Non-Structural Alternative entails a modification to the computerized LoadMax system and is otherwise identical to the No Action Alternative. The Government and Sponsor Disposal Plans both impact lands adjacent to the Columbia River which provide wildlife habitat value. Disposal sites identified for the separate Government and Sponsor Disposal Plans do not vary

with change in depth for the 41', 42' and 43' Structural Alternatives. Only height of the disposal material at a specific site will vary with depth of the Structural Alternative. Wildlife impacts are discussed below for both disposal plans.

4.3.1. Government Disposal Plan

Implementation of the Government Disposal Plan would require mitigation of wildlife habitat losses that would occur at 16 disposal locations (Table 4). The emphasis on avoidance of wetland and riparian habitat during the selection process for disposal sites resulted in the majority of habitat impacts encompassing agricultural lands. An estimated 398 acres of agricultural lands would be lost due to dredged material deposition. Agricultural lands impacted by disposal actions are principally pasturelands and cereal grain/row crop fields. This habitat is probably most important to wintering waterfowl, particularly Canada geese, but also provides habitat for many other species depending upon the type of crop grown, grazing intensity by cattle, and agricultural land management practices. The agricultural loss acreage includes 25 acres identified as farmed wetland; these locations are sites that in the absence of agricultural management practices (e.g., tillage, drainage) would convert to wetland habitats.

An estimated 71,914 acres of agricultural lands occur within Clark, Cowlitz and Wahkiakum Counties as of 1992 (U.S. Dept. Commerce 1992a); 103,133 acres in Multnomah and Columbia Counties, Oregon (U.S. Dept. Commerce 1992b). Project-related losses of agricultural lands are very minor in comparison to the total agricultural acres present in the project area, e.g. 175,047 acres.

Riparian habitat losses are estimated at 66 acres. Thirty-two acres of riparian habitat losses were early successional stage riparian forest representing cottonwood trees pioneering onto dredged material disposal sites that had been idle for 10 years or greater. Twenty-six acres of riparian forest at O-64.8 and O-63.5, represented by cottonwood dominated forests estimated to be 25-50 plus years of age, would be impacted by disposal. The balance of riparian habitat impacted are small inclusions of riparian trees, degraded by cattle grazing, located in otherwise agricultural settings.

Riparian forested habitats along the lower Columbia River have exhibited a substantial decline in acreage from historic (circa 1880s) levels (Graves 1995; Corps of Engineers 1996). Cottonwood and ash forests have declined 13,800 acres to approximately 2,240 acres or 14 percent of their historic acreage. Forested swamp habitats have decreased by 27,000 acres to 10,851 acres or approximately 29 percent of their historic levels. Although riparian habitat losses that are project related are minor in terms of acreage, concern over cumulative loss of this habitat is a resource agency concern.

Wetland habitat losses are estimated at 38 acres. These losses occurred at three locations and include wetland habitat associated with drainage ditches and land grazed lightly by livestock. Wetlands also represent an important habitat along the lower Columbia River. Wetland and marsh habitats, excluding forested wetlands, have been reduced by approximately 52,000 acres to 22,181 acres along the lower Columbia River from historic levels (Graves 1995; Corps of

Engineers 1996). The remaining acreage represents approximately 30 percent of the historic total.

The HEP analysis (Exhibit G), with AAHU's adjusted to discount bias associated with a different number of target species per habitat classification, indicated a project-related loss of 926 AAHUs (Table 29). A 5% contingency increase in AAHU's lost was added to the loss total to account for incidental habitat losses associated with pipeline right-of-way impacts and drainage channels. Thus, the total loss of AAHU's associated with the Government Disposal Plan was estimated at 972 AAHUs (Table 29).

Although the individual species loss totals were not adjusted (Table 29), they do provide direct evidence regarding which species incur the most project-related impacts. Canada geese, mallard and savannah sparrows would be most impacted by disposal. This is a reflection of disposal siting on agricultural lands. Disposal impacts to other species (Table 29), which occur primarily in wetland and/or riparian habitat, are relatively minor which reflects the avoidance measures for riparian and wetland habitats implemented during disposal site selection.

Table 29. Loss in AAHUs for target species and for general habitats, Government Disposal Plan.

		HABITATS		SPECIES
Target Species	Wetland	Riparian	Agriculture	Totals
Amphibian	-19.2	-4.0	-44.4	-67.7
Canada Goose	-20.75	0.0	-256.3	-277.1
Mallard	-25.7	-63.0	-207.3	-296.0
Savannah Sparrow	0.0	0.0	-147.0	-147.0
Black-capped Chickadee	0.0	-34.0	0.0	-34.0
Yellow Warbler	0.0	-39.4	0.0	-39.4
Cooper's Hawk	0.0	-68.7	0.0	-68.7
Mink	-25.7	-51.8	0.0	-77.5
Song Sparrow	-33.57	-39.4	0.0	-73.0
Habitat AAHU Totals	-124.9	-300.3	-655.0	-1080.2
Total Adjusted AAHU's	-99.9	-171.2	-655.0	-926.1
Adjusted AAHUs plus 5%**	-104.9	-179.7	-687.8	-972.4
* Adjustment: Wetland AAHUs x .8; Riparian AAHUs x .57.				
** Plus 5%; the contingency attached to adjusted AAHUs.				

4.3.2. Sponsor Disposal Plan

Implementation of the Sponsor Disposal Plan would require mitigation of wildlife habitat losses that would occur at 13 disposal locations (Table 5). The emphasis on avoidance of wetland and riparian habitat during the selection process for disposal sites resulted in the majority of habitat impacts encompassing agricultural lands. An estimated 289 acres of agricultural lands would be lost due to dredged material deposition. Agricultural lands impacted by disposal actions are principally pasturelands and cereal grain/row crop fields. This habitat is probably most important to wintering waterfowl, particularly Canada geese, but also provides habitat for many other species depending upon crop grown, grazing pressure by cattle, management practices and other factors.

Riparian habitat losses are estimated at 68 acres. Thirty-two acres of riparian habitat losses were early successional stage riparian forest representing cottonwood trees pioneering onto dredged material disposal sites that had been idle for 10 years or greater. Twenty-six acres of riparian forest at O-64.8 and O-63.5, represented by cottonwood dominated forests estimated to be 25-50 plus years of age, would be impacted by disposal. The balance of riparian habitat impacted are small inclusions of riparian trees, degraded by cattle grazing, located in otherwise agricultural settings.

Wetland habitat losses are estimated at 30 acres. These losses occurred at two locations and entails wetland habitat grazed lightly by livestock.

The HEP analysis (Exhibit G), with AAHUs adjusted to discount bias associated with a different number of target species per habitat classification, indicated a project-related loss of 459 AAHUs (Table 30). A 5% contingency increase in AAHUs lost was added to the loss total to account for incidental habitat losses associated with pipeline right-of-way impacts and drainage channels. Thus, total loss of AAHUs associated with the Sponsor's Disposal Plan was estimated at 482 AAHUs (Table 30).

Although the individual species loss totals were not adjusted (Table 30), they do provide direct evidence regarding which species incur the most project-related impacts. Canada geese and mallards would be most impacted by disposal. This is a reflection of disposal siting on agricultural lands. Disposal impacts to other species (Table 30), which occur primarily in wetland and/or riparian habitat, are relatively minor which reflects the avoidance measures for riparian and wetland habitats implemented during disposal site selection.

Relative to the Government Disposal Plan, the Sponsor Disposal Plan has less impact on wildlife habitat. This is a function of pumping dredged material greater distances in order to place material in the Lonestar and Morse Brothers Gravel Pits, thus obviating the need for a number of disposal sites on agricultural lands. The Sponsor Disposal Plan also utilizes Gateway 3, agricultural land owned by the Port of Vancouver, which is zoned and slated for full industrial development by 2016. Factoring in industrial build out of Gateway 3 for the without project condition results in fewer AAHUs of loss than if the site were to remain in agricultural production for the project life, e.g., 50 years. The Government Plan is also driven by cost, with the objective of being the least cost, engineeringly sound, environmentally acceptable. Wildlife mitigation efforts were considered an environmentally acceptable means to offset project-related wildlife habitat losses.

Table 30. Loss in AAHUs for target species and for general habitats, Sponsor Disposal Plan.

		HABITATS		SPECIES
	Wetland	Riparian	Agriculture	Totals
Amphibian	-15.35	-3.98	-12.64	-32.0
Canada Goose	-16.55	0.0	-76.74	-93.3
Mallard	-20.47	-67.41	-62.06	-149.9
Savannah Sparrow	0.0	0.0	-44.01	-44.0
Black-capped Chickadee	0.0	-36.96	0.0	-37.0
Yellow Warbler	0.0	-42.11	0.0	-42.1
Cooper's Hawk	0.0	-73.99	0.0	-74.0
Mink	-20.47	-56.38	0.0	-76.9
Song Sparrow	-26.79	-42.11	0.0	-68.9
Habitat AAHU Totals	-99.6	-322.9	-195.45	-618.0
Total Adjusted AAHUs*	-79.7	-184.1	-195.45	-459.2
Adjusted AAHUs plus 5%**	-83.7	-193.3	-205.2	-482.2
* Adjustment: Wetland AAHUs x .8; Riparian AAHUs x .57.				
** Plus 5%; the contingency attached to adjusted AAHUs.				

Losses in AAHUs on a site specific basis (Table 31) generally reflect the amount of acreage proposed for disposal use. Use of locations such as O-90.6 (Scappoose Dairy), W-80.7 (Martin Island) and W-44.0 (Puget Island) would generate the greatest loss of AAHUs. These locations entail 80-107 acres of land each. Use of existing or former dredged material disposal locations with pioneering riparian vegetation, e.g., W-82.0, O-77.0, W-70.1 and others, would result in minor to moderate impacts on wildlife habitat (Table 31).

Table 31. Site specific wildlife habitat losses in AAHUs for the Government and Sponsor Disposal Plans. Losses in AAHUs were mathematically adjusted and a 5% contingency factor was added.

PROPOSED DISPOSAL SITE	Government Disposal Plan	Sponsor Disposal Plan
REACH 1- Columbia River Miles 98-105		
O-98.5 – Sauvie 1	-84.5	
W-101 Gateway 3		-28.7
REACH 2 – Columbia River Miles 84-98		
W-96.9 - Adj. Fazio S&G	-15.6	
W-96.5 – N. Dike Field	-47.6	
W-95.7	-44	
O-90.6 - Scappoose Dairy	-210.1	
W-86.5 - Austin Point	-1.8	-1.8
Lonestar Gravel Pit		-9.6
REACH 3 – Columbia River Miles 70-84		
W-82.0 - Martin Bar	-2.1	-2.1
W-80.0 - Martin Island	-136.7	
Morse Bro. Gravel Pit		-9.8
O-77.0 - Deer Island*	-26.7	-26.7
W-70.1- Cottonwood Island	-19	-19
REACH 4 – Columbia River Miles 56-70		
W-68.7 - Howard Is.	-22.9	-22.9
O-64.8*	-16.1	-16.1
O-63.5*	-40	-40
W-62.0 - Mt. Solo	-82.7	-82.7
W-59.7 - Hump Island	-49.3	-49.3
REACH 5 – Columbia River Miles 41-56		
W-44.0 - Puget Island	-173.4	-173.4
Total	-972.5	-482.1

5. WILDLIFE MITIGATION PLANS

The mitigation phase of the HEP analysis focused on determination of the level of recovery associated with proposed mitigation actions at individual and combinations of mitigation sites. The overall mitigation objective was to equitably offset project related losses of wildlife habitat. Mitigation strategies were developed for both the Government and Sponsor Disposal Plans.

Initially, a number of mitigation sites were identified along the entire reach of the Columbia River encompassed by the project (Table 32). These initial mitigation sites were generally selected on the basis of large tracts of land with good potential for habitat development and their nearness to National Wildlife Refuges or State Wildlife Management Areas. Several sites identified by individuals during the course of public meetings were also given consideration.

The initial list of mitigation sites was pared from 13 sites to 9 sites for inclusion in a more detailed planning process (Table 32). Nine mitigation sites were considered more than adequate to address project-related losses and it was more cost and time efficient to plan and analyze a smaller subset of sites. The reduction in number of mitigation sites considered further in the study was based upon an initial analysis of site costs versus acreage. The initial analysis considered estimated acquisition, development and operation and maintenance costs. The most costly sites were eliminated from further consideration. Mitigation concepts, habitat maps, infrastructure, and detailed costs were then developed for each of the 9 proposed mitigation sites on the preliminary list (Table 32).

Table 32. Potential Mitigation Sites for Columbia River Channel Improvement Study.

Mitigation Site (Basic List – 1997 Public Meetings)	State	Initial List	Preliminary Planning List*	Government Disposal Plan	Sponsor Disposal Plan
Joslin Property**	OR	X	X	X	X
Vancouver Lowlands	WA	X	X		
Sauvie 94	OR	X	X	X	X
Scappoose Dairy	OR	X			
Woodland Bottoms	WA	X	X	X	
Burke Island	WA	X	X		
Martin Island	WA	X	X	X	
RN&D Development	WA	X			
Port Westward	OR	X			
Clatskanie	OR	X			
Webb	OR	X	X	X	X
Vik (Puget Island)**	WA	X	X		
Svensen Island	OR	X	X		
* Sites for which detailed plans and costs were developed.					
** Mitigation sites added after 1997 Public Meetings per landowner comments.					

Conceptual mitigation measures for each proposed mitigation site on the preliminary list were based upon the physical features at each location, review of aerial photography, and site visits. The interagency HEP team visited the proposed mitigation sites, management prescriptions were provided for their review and management recommendations were sought from the team members. The HEP team recommended an emphasis on wetland and riparian habitat development in the mitigation plan in order to begin addressing the significant losses these habitats have historically incurred in the region. The conceptual mitigation measures for each of the 9 preliminary mitigation sites are presented in Exhibit F. Maps detailing baseline habitat

conditions, proposed physical features and post-implementation habitat polygons and their acreage for each mitigation site are included in Exhibit C.

These potential mitigation sites were then analyzed to determine their baseline value to wildlife. Existing habitats at potential mitigation sites were identified and quantified to determine the baseline habitat conditions for each site (Tables 33-41; Exhibit C). Physical measures that could be employed at each site to develop riparian, wetland or agricultural habitat features were then identified (Exhibit F). The habitats developed through implementation of these mitigation features were then quantified (Tables 33-41) and mapped (Exhibit C).

The Joslin Property at the upstream end of Sauvie Island is currently used for grazing livestock, including low lying areas that are wetlands and riparian forest inclusions that occur at the site. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 33. The mitigation concepts at Joslin Property are directed toward development of wetland and riparian habitats. The site is approximately 124 acres in extent. Riparian habitat management (41.4 acres) and development (28.7 acres) would encompass 70.1 acres. Approximately 50.5 acres of wetland habitat would be developed and enhanced through construction of a levee and associated water control structures.

Table 33. Habitat acreage for the with and without project condition, Joslin Property mitigation site.

	WITH PROJECT CONDITION					WITHOUT PROJECT CONDITION				
	Target Year Acreage					Target Year Acreage				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	50.5	50.5	50.5	50.5	0	0	0	0	0
Wetland - Farmed	29.7	0	0	0	0	29.7	29.7	29.7	29.7	29.7
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	7.3	7.3	7.3	7.3	0	0	0	0	0
Riparian - Degraded	7.3	0	0	0	0	7.3	7.3	7.3	7.3	7.3
Riparian Early Success.	0	5.2	5.2	5.2	5.2	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	36.8	2.7	2.7	2.7	2.7	36.8	36.8	36.8	36.8	36.8
Riparian Assoc. Hab.	0	34.1	34.1	34.1	34.1	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	23.5	23.5	23.5	23.5	0	0	0	0	0
Ag. Cropland	0	0	0	0	0	0	0	0	0	0

Assoc. Hab. - Ag. Crop.	31.4	0	0	0	0	31.4	31.4	31.4	31.4	31.4
Assoc. Hab. - Ag. Crop. – Degraded	13	0	0	0	0	13	13	13	13	13
Ag. Cropland - Degraded – Blackberry thickets	5.2	0	0	0	0	5.2	5.2	5.2	5.2	5.2
Other (levee, houses, bldgs)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Embayment	0	0	0	0	0	0	0	0	0	0
Total	124.5	124.4	124.4	124.4	124.4	124.5	124.5	124.5	124.5	124.5

The Vancouver Lowlands site targeted for mitigation actions is presently used for agricultural crop production. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 34. The mitigation concepts at Vancouver Lowlands are directed toward development of forage for Canada geese. Permanent grassland, principally for waterfowl (Canada goose) forage would be developed on 273 acres. Post-migration of geese in mid-April, the grassland would be allowed to grow and seed out in order to benefit grassland bird species, raptors, reptiles, amphibians and small rodents. Each fall, agricultural practices would be employed to return the site to a short grass stand in order to again provide winter forage for Canada geese.

Table 34. Habitat acreage for the with and without project condition, Vancouver Lowlands mitigation site.

	WITH PROJECT CONDITION					WITHOUT PROJECT CONDITION				
	Target Year Acreage					Target Year Acreage				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	0	0	0	0	0	0	0	0	0
Wetland - Farmed	0	0	0	0	0	0	0	0	0	0
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	0	0	0	0	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	0	0	0	0	0	0	0	0	0
Ag. Cropland	132	132	132	132	132	132	132	132	132	132
Assoc. Hab. - Ag. Crop.	140.7	140.7	140.7	140.7	140.7	140.7	140.7	140.7	140.7	140.7
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
Embayment	0	0	0	0	0	0	0	0	0	0
Total	288.1	288.1	288.1	288.1	288.1	288.1	288.1	288.1	288.1	288.1

The Sauvie 94 location targeted for mitigation actions is presently used for agricultural crop production and grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 35. The mitigation concepts at Sauvie 94 are directed toward development of wetland, riparian and Canada goose forage habitats. The site is approximately 204 acres in extent. Permanent Canada goose forage habitat would be developed on approximately 116 acres at this location. Riparian habitat development (7.5 acres) and enhancement (12.6 acres) would encompass approximately 20 acres. Approximately 68 acres of wetland habitat would be developed.

Table 35. Habitat acreage for the with and without project condition, Sauvie 94 mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland		68.4	68.4	68.4	68.4					
Wetland - Farmed	36.7	0	0	0	0	36.7	36.7	36.7	36.7	36.7
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	0	0	0	0	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	12.6	0	0	0	0	12.6	12.6	12.6	12.6	12.6
Riparian Assoc. Hab.	0	12.6	12.6	12.6	12.6	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	7.5	7.5	7.5	7.5	0	0	0	0	0
Ag. Cropland	30	32.1	32.1	32.1	32.1	30	30	30	30	30
Assoc. Hab. - Ag. Crop.	122.4	83.9	83.9	83.9	83.9	122.4	122.4	122.4	122.4	122.4
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	2.8					2.8	2.8	2.8	2.8	2.8
Embayment	0	0	0	0	0	0	0	0	0	0
Total	204.5	204.5	204.5	204.5	204.5	204.5	204.5	204.5	204.5	204.5

The Woodland Bottoms location targeted for mitigation actions is currently in agricultural production, principally row crops, hybrid poplars and pasturelands. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 36. The mitigation concepts at Woodland Bottoms are directed toward development of wetland, riparian and Canada goose forage habitats. The site is approximately 284 acres in extent. Permanent Canada goose forage habitat would be developed on approximately 132 acres at this location. Riparian habitat development and management would encompass approximately 44 acres. Approximately 97 acres of wetland habitat would be developed.

Table 36. Habitat acreage for the with and without project condition, Woodland Bottoms mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	96.7	96.7	96.7	96.7	0	0	0	0	0
Wetland - Farmed	109	0	0	0	0	109	109	109	109	109
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	2.6	2.6	2.6	2.6	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	0.8	0	0	0	0	0.8	0.8	0.8	0.8	0.8
Riparian Assoc. Hab.	0	0.8	0.8	0.8	0.8	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	40.9	40.9	40.9	40.9	0	0	0	0	0
Ag. Cropland	23.2	20.7	20.7	20.7	20.7	23.2	23.2	23.2	23.2	23.2
Assoc. Hab. - Ag. Crop.	126.4	111.7	111.7	111.7	111.7	126.4	126.4	126.4	126.4	126.4
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	25.4	10.8	10.8	10.8	10.8	25.4	25.4	25.4	25.4	25.4
Embayment	0	0	0	0	0	0	0	0	0	0
Total	284.8	284.2	284.2	284.2	284.2	284.8	284.8	284.8	284.8	284.8

The Burke Island location targeted for mitigation actions is presently used for agricultural crop production and grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 37. The mitigation concepts at Burke Island are directed toward development of wetland and riparian habitats. Construction actions for development of mitigation habitat will entail approximately 164 acres. Riparian habitat development would encompass approximately 122 acres. Approximately 31 acres of wetland habitat would be developed and better management practices implemented on an additional 11 acres of wetlands currently subject to grazing by livestock

Table 37. Habitat acreage for the with and without project condition, Burke Island mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
	0	1	5	25	50	0	1	5	25	50
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	42.3	42.3	42.3	42.3	0	0	0	0	0
Wetland - Farmed	11.1	0	0	0	0	11.1	11.1	11.1	11.1	11.1
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	0	0	0	0	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	121.9	121.9	121.9	121.9	0	0	0	0	0
Ag. Cropland	39.5	0	0	0	0	39.5	39.5	39.5	39.5	39.5
Assoc. Hab. - Ag. Crop.	111.3	0	0	0	0	111.3	111.3	111.3	111.3	111.3
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	83.7	82	82	82	82	83.7	83.7	83.7	83.7	83.7
Embayment	0	0	0	0	0	0	0	0	0	0
Total	245.6	246.2	246.2	246.2	246.2	245.6	245.6	245.6	245.6	245.6

The Martin Island location targeted for mitigation actions is presently used for grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 38. The mitigation concept at Martin Island is two-fold. Management emphasis will be directed toward riparian forest and emergent marsh habitat. Reestablishment of riparian forest habitat will encompass the majority of the acreage at this location. This will entail the development of riparian forest on the acreage currently devoted to cattle pasture. Improvement in habitat conditions for the existing block of riparian forest is also forecast with removal of cattle from the island but will not require physical measures on the landscape. Emergent marsh habitat (32 acres) would be developed in the previously constructed embayment at Martin Island. Development of emergent marsh habitat at this location would initially entail disposal of dredged material in the embayment to bring the bottom elevation to near the point where emergent marsh vegetation would become established. Top-soil would be borrowed from the waste area on Martin Island that resulted from the embayment construction to provide two feet of soil atop the sand placed in the embayment. Site elevation would be designed to allow for emergent marsh habitat development under normal tidal conditions.

Table 38. Habitat acreage for the with and without project condition, Martin Island mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	6.9	6.9	6.9	6.9	0	0	0	0	0
Wetland - Farmed	6.9	0	0	0	0	6.9	6.9	6.9	6.9	6.9
Intertidal Emergent Wet.	0	32.1	32.1	32.1	32.1	0	0	0	0	0
Riparian	0	10.8	10.8	10.8	10.8	0	0	0	0	0
Riparian - Degraded	10.8	0	0	0	0	10.8	10.8	10.8	10.8	10.8
Riparian Early Success.	0	61.1	61.1	61.1	61.1	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	73.9	0	0	0	0	73.9	73.9	73.9	73.9	73.9
Riparian Assoc. Hab.	0	73.9	73.9	73.9	73.9	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	98.3	98.3	98.3	98.3	0	0	0	0	0
Ag. Cropland	61.1	0	0	0	0	61.1	61.1	61.1	61.1	61.1
Assoc. Hab. - Ag. Crop.	39.4	0	0	0	0	39.4	39.4	39.4	39.4	39.4
Assoc. Hab. - Ag. Crop. - Degraded	58.9	0	0	0	0	58.9	58.9	58.9	58.9	58.9
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (beaches, water)	127.3	95.2	95.2	95.2	95.2	127.3	127.3	127.3	127.3	127.3
Total	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3	378.3

The Webb Diking District location targeted for mitigation actions is presently used for grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 39. The mitigation concepts at Webb Property are directed toward development of wetland and riparian habitat. The site is approximately 145.6 acres in extent. Riparian habitat development would encompass approximately 42 acres. Approximately 101 acres of wetland habitat would be developed through construction of two low levees.

Table 39. Habitat acreage for the with and without project condition, Webb Island mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0.3	100	100	100	100	0.3	0.3	0.3	0.3	0.3
Wetland - Farmed	141.1	0	0	0	0	141.1	141.1	141.1	141.1	141.1
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	0	0	0	0	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	1.7	0	0	0	0	1.7	1.7	1.7	1.7	1.7
Riparian Assoc. Hab.	0	1.1	1.1	1.1	1.1	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	42	42	42	42	0	0	0	0	0
Ag. Cropland	0	0	0	0	0	0	0	0	0	0
Assoc. Hab. - Ag. Crop.	0	0	0	0	0	0	0	0	0	0
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Embayment										
Total	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6	145.6

The Puget Island location targeted for mitigation actions is presently used for grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 40. The mitigation concepts at Vik Property are directed toward development of wetland and riparian habitats. Riparian habitat development would encompass approximately 76 acres. Approximately 31 acres of wetland habitat would be developed.

Table 40. Habitat acreage for the with and without project condition, Puget Island mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	32.8	32.8	32.8	32.8	0	0	0	0	0
Wetland - Farmed	20	0	0	0	0	20	20	20	20	20
Intertidal Emergent Wet.	0	0	0	0	0	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	0	0	0	0	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	76.2	76.2	76.2	76.2	0	0	0	0	0
Ag. Cropland	0	0	0	0	0	0	0	0	0	0
Assoc. Hab. - Ag. Crop.	89	0	0	0	0	89	89	89	89	89
Assoc. Hab. - Ag. Crop. - Degraded	0	0	0	0	0	0	0	0	0	0
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Embayment	0	0	0	0	0	0	0	0	0	0
Total	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1

The Svensen Island location targeted for mitigation actions is presently used for grazing of livestock. Acreage distribution amongst habitat types for the with and without project condition at this location are displayed in Table 41. The mitigation concept at Svensen Island entails construction of 7 levee breaches and planting of riparian habitat on the existing levee right-of-way and disposal sites for levee borrow material. The constructed breaches would have no flow control structures. Natural tidal inundation would be allowed in order to develop an intertidal marsh and/or shallow subtidal habitat.

Table 41. Habitat acreage for the with and without project condition, Svensen Island mitigation site.

	WITH PROJECT CONDITION TARGET YEAR ACREAGE					WITHOUT PROJECT CONDITION TARGET YEAR ACREAGE				
Habitat	2002	2003	2007	2027	2052	2002	2003	2007	2027	2052
	TY-0	TY-1	TY-5	TY-25	TY-50	TY-0	TY-1	TY-5	TY-25	TY-50
Wetland	0	0	0	0	0	0	0	0	0	0
Wetland - Farmed	14.3	0	0	0	0	14.3	14.3	14.3	14.3	14.3
Intertidal Emergent Wet.	0	268.4	268.4	268.4	268.4	0	0	0	0	0
Riparian	0	0	0	0	0	0	0	0	0	0
Riparian - Degraded	0	0	0	0	0	0	0	0	0	0
Riparian Early Success.	0	13.5	13.5	13.5	13.5	0	0	0	0	0
Rip. Assoc. Hab. - Degrad.	28.4	0	0	0	0	28.4	28.4	28.4	28.4	28.4
Riparian Assoc. Hab.	0	0	0	0	0	0	0	0	0	0
Riparian Assoc. Hab.- E.S.	0	0	0	0	0	0	0	0	0	0
Ag. Cropland	0	0	0	0	0	0	0	0	0	0
Assoc. Hab. - Ag. Crop.	208.8	0	0	0	0	208.8	208.8	208.8	208.8	208.8
Assoc. Hab. - Ag. Crop. - Degraded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ag. Cropland - Degraded - Blackberry thickets	0	0	0	0	0	0	0	0	0	0
Embayment	0	0	0	0	0	0	0	0	0	0
Other (levee, houses, bldgs)	32.8	2.1	2.1	2.1	2.1	32.8	32.8	32.8	32.8	32.8
Total	284.3	284	284	284	284	284.3	284.3	284.3	284.3	284.3

5.1. Growth and Successional Rates

Target species habitat suitability indices were initially developed for mitigation sites based upon analysis of habitat variables obtained from field measurements or estimates derived from aerial photo interpretation and site observations. Habitat growth and successional rates were also taken into account during development of species-specific spreadsheets detailing habitat suitability indices by habitat and target year for the with and without project condition. The application of growth and successional rates for mitigation sites is discussed on a species and habitat basis in the following tables and text.

The incremental increase in wildlife habitat value (HSI) across target years that can be attained through implementation of wildlife mitigation measures was estimated for each target species. Future projections were based on field sampling of habitat variables in representative habitats and professional judgment. Factors considered when projecting HSI values across target years by habitat for a species included types of cover that would develop, timing of cover/habitat development, response of the vegetation community to mitigation measures, and structural features of the habitat that would develop, amongst others. Typically, the maximum HSI value as determined for a target species from measurement of field habitat variables was used as the upper limit of mitigation values to be attained. An exception was for Canada geese and mallards where optimum values (1.0) were estimated to be attained for certain habitats.

Table 42 depicts all 15 habitat types considered in the mitigation HEP analysis in order to reacquaint the reader with the habitat types considered in this. Those habitats not used by pond-breeding amphibians have a zero entered as the HSI value (Table 42). All subsequent species tables depicting HSI values only report the habitat that the target species would use. This conformity was enacted to lessen the complexity of the tables. Table 7 depicts the habitats used by each target species.

Pond-breeding Amphibians

Mitigation HSI values for pond-breeding amphibians (Table 42) are comparable to those developed for analysis of disposal sites with four exceptions. Riparian associated habitat (RAH) HSI values for the with project condition reflect the conversion from riparian associated habitat – degraded (RAH-D) that occurs in TY1. The removal of cattle from RAH-D in TY1 will result in the natural recovery of understory vegetation, both herbaceous and shrub species, and the establishment of tree seedlings and their subsequent recruitment into the stand. No quality change is reflected in TY1 for RAH as it is too early in the conversion from RAH-D for the vegetation community to have responded. Quality changes for RAH are reflected in TY5, TY25 and TY50 as the vegetative community recovers and progresses in vegetative structural and species complexity. The change is quality was estimated to occur in a linear fashion and would not exceed the maximum HSI value, e.g., 0.36, determined from field measurements.

Table 42. Mitigation HSI values for pond-breeding amphibians by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Wetland - Farmed	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Intertidal Emergent Wet.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian - Degraded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian-Early Succ.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Riparian Assoc. Hab. - Degrad.	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Riparian Assoc. Hab.	0.36	0.12	0.24	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Riparian Assoc. Hab.- E.S.	0.12	0.05	0.12	0.24	0.36	0.12	0.12	0.12	0.24	0.36
Ag. Cropland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Assoc. Hab. - Ag. Crop.	0.21	0.21	0.40	0.40	0.40	0.21	0.21	0.21	0.21	0.21
Assoc. Hab. - Ag. Crop. - Degraded	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Ag. Cropland - Degraded - Blackberry thickets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dredged Material	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Riparian Associated Habitat – Early Successional (RAH-ES) differs only in the quality value reported for TY1 when compared to the quality values reported for this habitat type at disposal sites. This difference is attributable in that RAH-ES habitat in the disposal analysis represented trees and shrubs that were already pioneering onto a location. For mitigation sites, RAH-ES would be planted or site conditions optimized for establishment of riparian cuttings and/or seedlings. Consequently, under the mitigation scenario, only a negligible value of 0.05 was

assigned in TY1. Otherwise, the quality values were comparable for this habitat type between the disposal and mitigation evaluations.

Associated habitat - agricultural cropland (AH-AG) in the mitigation analysis differed (higher quality values) in TY5, TY25 and TY50 from the disposal analysis. The mitigation concept for agricultural cropland prescribed the development of tall, dense grass-forb cover from approximately mid-March to early October. The development of tall, dense grasses and forbs would provide for more optimum cover, thermal and foraging habitat for amphibians when compared to grazed pastures and row crop agricultural lands analyzed for disposal sites.

Associated habitat – agricultural cropland – degraded (AH-AG-D) was not a habitat type analyzed for disposal sites. This habitat type was present on Joslin and Martin Island mitigation sites. The degraded condition was associated with the presence of blackberry thickets on sites subject to grazing by livestock. The quality value assigned, e.g., 0.11, was approximately 50 percent of the value for the AH-AG habitat type.

Canada Geese

Mitigation HSI values for Canada geese (Table 43) differed from those identified for disposal sites only for the Intertidal Emergent Wetland (IEW), Agricultural Cropland (AG) and AH-AG habitats. The difference in quality value for IEW only occurred in TY1 and reflects the low value (0.05) expected with construction of the habitat in that year. The quality value in TY1 for AG habitat reflects development of the permanent grass pasture that year. For TY5, TY25 and TY50, the quality value for AG and AH-AG was increased to the optimum value (1.0) to reflect the forage management practices, lack of disturbance and field size associated with the mitigation action.

Table 43. Mitigation HSI values for Canada geese by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Wetland - Farmed	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Intertidal Emergent Wet.	0.55	0.05	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Ag. Cropland	0.68	0.34	1.00	1.00	1.00	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop.	0.68	0.68	1.00	1.00	1.00	0.68	0.68	0.68	0.68	0.68
Assoc. Hab. - Ag. Crop. - Degraded	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Ag. Cropland - Degraded - Blackberry	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34

thickets										

Mallard

Mitigation HSI values for mallards (Table 44) differed from those identified for disposal sites only for the Intertidal Emergent Wetland (IEW), riparian (R), riparian early successional (R-ES), riparian associated habitat (R-AH), and riparian associated habitat –early successional (R-AH-ES) habitats. No IEW was impacted in disposal siting, thus the habitat did not receive an HSI value during that analysis. It was assumed that IEW rated an HSI value of 1.0 given it's intensive use in the lower Columbia River by wintering mallards. The mitigation HSI value in TY1 for IEW was assumed to be only 0.1. The 0.1 value in TY1 reflects the initial development year for IEW when species composition, seed and forage production, and vegetative structural diversity of the habitat would not have developed. These features were estimated to be present by TY5, thus the HSI value was estimated to be 1.0.

The HSI value for riparian habitat was estimated to be 0.21 in TY1, approximately one-third the calculated value for riparian habitat. For mitigation sites, R-D habitat was converted to riparian habitat through the removal of cattle in TY1. The physical condition of riparian habitat in TY1 would still be greatly influenced by livestock grazing that was just discontinued. Grass-forb ground cover, shrub cover and recruitment of trees (seedlings) would be in the early stage of recovery, thus habitat quality would be comparable to R-D in TY1. A tall, dense ground and shrub cover plus recruitment of tree seedlings would occur by TY5. These conditions would raise the HSI value to that determined for riparian habitat from field sampling and estimates of habitat variables for mallards.

Riparian Associated Habitat – Early Successional (RAH-ES) differs only in the quality value reported for TY1 when compared to the quality values reported for this habitat type at disposal sites. This difference is attributable in that RAH-ES habitat in the disposal analysis represented trees and shrubs that were already pioneering onto a location. Thus for mallards, grass-forb and shrub cover would be present which would provide them nesting opportunities. For mitigation sites, RAH-ES would be planted or site conditions optimized for establishment of riparian cuttings and/or seedlings in TY1. Thus, minimal grass-forb and shrub cover for mallard nesting would be present. Consequently, under the mitigation scenario, only a negligible value of 0.05 was assigned in TY1 as vegetative features of riparian habitat would negligible. A substantial grass-forb and shrub cover with young trees would by present by TY5 that would be used by nesting mallards. The quality value was thus raised to 0.64 to reflect nesting habitat conditions. This discussion is also applicable to R-ES habitat.

Riparian Associated Habitat (RAH) was estimated to have a quality value of 0.32 in TY1. This habitat quality gain is attained by converting RAH-D to RAH through implementation of management measures such as cattle removal in TY1. The removal of grazing would allow for recovery of grasses, forbs, and shrubs plus recruitment of trees into the stand to occur. Recovery of ground and shrub cover would benefit mallard nesting through provision of cover and concealment. The quality value of 0.32 appears to be in error and should be 0.21(comparable to riparian habitat developed from R-D habitat). This correction will be implemented upon completion of a review of the draft EIS and receipt of all comments.

Table 44. Mitigation HSI values for mallard by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.68	0.68	0:68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Intertidal Emergent Wet.	1.00	0.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Riparian	0.64	0.21	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian - Degraded	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian-Early Succ.	0.21	0.10	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Riparian Assoc. Hab. - Degrad.	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Riparian Assoc. Hab.	0.64	0.32	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Riparian Assoc. Hab.- E.S.	0.21	0.10	0.64	0.64	0.64	0.21	0.21	0.64	0.64	0.64
Ag. Cropland	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop.	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Assoc. Hab. - Ag. Crop. - Degraded	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Ag. Cropland - Degraded - Blackberry thickets	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Savannah Sparrows

The mitigation HSI spreadsheet for savannah sparrows (Table 45) differs from that developed for disposal sites in that Wetland-Farmed was not considered and Associated Habitat – Agricultural Cropland – Degraded (AH-AG-D) was added in the mitigation analysis. The failure to consider Wetland-Farmed habitat is an oversight that will be corrected after receipt of all draft EIS review comments. The HSI values identified in Table 45 are otherwise comparable to those in the disposal plan. The HSI values identified for AH-AG-D mirror those for AG-D.

Table 45. Mitigation HSI values for savannah sparrows by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Ag. Cropland	0.39	0.39	0.80	0.80	0.80	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop.	0.39	0.39	0.80	0.80	0.80	0.39	0.39	0.39	0.39	0.39
Assoc. Hab. - Ag. Crop. - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Ag. Cropland - Degraded - Blackberry thickets	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13

Black-capped Chickadees

Mitigation HSI values for black-capped chickadees presented in Table 46 are comparable to those presented for disposal sites except for values in TY1 for Riparian, Riparian-Early Successional, Riparian Associated Habitat, and Riparian Associated Habitat - Early Successional habitats. The conversion of Riparian Degraded to Riparian and Riparian Associated Habitat – Degraded to Riparian Associated Habitat contributed to the projected 0.15 HSI value in TY1. The two degraded riparian habitats do not possess the shrub-young tree understory of a undisturbed forest, thus it was projected that foraging habitat and insect populations would be less available to chickadees. Recovery of the shrub-young tree understory should occur by TY5, thus quality values were considered normal by then. The two early successional riparian habitats would be planted in TY1 and consequently would offer no habitat features or forage for black-capped chickadees. As early successional riparian habitat develops from TY5 to TY50, habitat quality for black-capped chickadees increases to the quality value determined via field sampling of habitat variables.

Table 46. Mitigation HSI values for black-capped chickadees by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.44	0.15	0:44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian - Degraded	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian-Early Succ.	0.15	0.00	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44
Riparian Assoc. Hab. - Degrad.	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Riparian Assoc. Hab.	0.44	0.15	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Riparian Assoc. Hab.- E.S.	0.15	0.00	0.15	0.29	0.44	0.15	0.15	0.15	0.29	0.44

Yellow Warbler

Mitigation HSI values for yellow warblers are presented in Table 47. The reported TY1 HSI value for Riparian habitat should be 0.13 rather than 0.00. Riparian habitat is attained by transferring acreage from Riparian – Degraded to Riparian and removal of the adverse management measures that led to the degradation of the habitat. The quality value assigned in TY1 would remain comparable to that previously assigned to Riparian – Degraded as vegetative recovery would not be instantaneous. Habitat quality for TY5, TY25 and TY50 was estimated to be comparable to that determined from field measurement of variables. Recovery of the shrub community plus tree recruitment would have occurred thus providing foraging and nesting habitat for yellow warblers.

Riparian Associated Habitat, derived from Riparian Associated Habitat – Degraded via changes in land management practices, should mirror the HSI values across target years as Riparian Habitat. The HSI value in TY1 for Riparian Associated Habitat should thus be 0.13 rather than 0.40. This error, along with that noted for Riparian habitat in TY1 will be corrected upon receipt of all comments on the draft EIS.

The reported HSI values in TY1 for the two early successional stage riparian habitats (0.00) reflect the planting/establishment year for that habitat. Structural complexity of the riparian community is considered absent in the first year. By TY5, planted and seedling trees should be 15-20 feet in height plus the shrub community should be well developed. This habitat development should provide foraging and nesting opportunities for yellow warblers and the HSI values for TY5, TY25, and TY50 were increased to the level obtained from measurement of habitat variables.

Table 47. Mitigation HSI values for yellow warblers by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.40	0.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian - Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.- E.S.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40

Cooper's Hawk

Mitigation HSI values for Cooper's hawks are reported in Table 48. Riparian and Riparian Associated Habitats are both derived as previously described. Their HSI values in TY1 should both be 0.26; Riparian Associated Habitat is erroneously reported as 0.77. This error will be corrected upon receipt of all comments on the draft EIS. The HSI value in TY1 for both habitats should be directly comparable to the degraded habitat condition from which they were derived. This is attributable to the lack of understory vegetation, particularly shrub habitat, which influences the amount of prey species (birds) available to Cooper's hawks. Lack of shrub cover would also influence hunting success of Cooper's hawk, as there is less cover to shield their approach. Habitat suitability values in subsequent target years were increased to the level attained from field measurement of variables. The increase is attributable to vegetative recovery.

The two early successional riparian habitats were projected to have no HSI value in TY1, which reflected their initial planting/seedling establishment period. Cover values and prey availability were considered non-existent in TY1 because of the virtual absence of vegetative cover. By TY5, planted and seedling trees should be 15-20 feet in height plus the shrub community should be well developed. This habitat development should provide foraging opportunities for Cooper's hawks and the HSI value was projected to be 0.26, one-third of the value derived from field measurements of habitat variables. HSI values for TY25 and TY50 were 0.77 and reflected the establishment of riparian forest habitat with a shrub and tree layer plus a diversity of forest birds for prey.

Table 48. Mitigation HSI values for Cooper's hawk by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Riparian	0.77	0.26	0:77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian - Degraded	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian-Early Succ.	0.26	0.00	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77
Riparian Assoc. Hab. - Degrad.	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Riparian Assoc. Hab.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
Riparian Assoc. Hab.- E.S.	0.26	0.00	0.26	0.77	0.77	0.26	0.26	0.26	0.77	0.77

Mink

Mitigation HSI values for mink are reported in Table 48. The wetland HSI value of 0.45 in TY1 reflects the initial recovery and/or establishment of vegetation expected upon conversion of farmland to wetland habitat and the development of a wetland water regime. For TY5, TY25, and TY50, the HSI value was projected to reach 0.85, a result of a natural water regime, development of wetland herbaceous and shrub cover, and a marked increase in prey species composition and numbers compared to a farmed wetland habitat. Intertidal emergent marsh, which is to be developed at Martin Island, would have a low quality value (e.g., 0.28) in TY1 as minimal vegetative development and prey species occurrence would be anticipated. By TY5, vegetative establishment and prey use of an intertidal emergent wetland would be expected to be high and the quality value was projected to reach 0.85 through TY50.

Riparian and Riparian Associated Habitats are both derived as previously described. Their quality value in TY1 should be 0.22 as habitat quality improvements from the degraded status from which they were developed would not be observed until subsequent years. Riparian associated habitat has an erroneous HSI value in TY1, e.g., 0.77; that error will be corrected upon receipt of all EIS review comments. HSI values in TY5, TY25, and TY50 were set at 0.67, the level determined from field measurements of habitat variables. The 0.67 quality value reflects the structural and species composition recovery of riparian forest vegetation from the degraded condition. The two early successional riparian habitats would exhibit no value for mink in TY1 as that is the year that plantings/establishment of riparian vegetation would occur and vegetative cover is minimal. The development of shrubs and herbaceous ground cover is reflected in the 0.22 HSI value assigned in TY5. The HSI value was increased to 0.45 in TY25 to reflect the establishment of trees on the site, increased shrub cover and the initial development of debris

cover. By TY50, HSI values were projected to reach 0.67 as down and dead material would begin to occur given windthrows and snappage. Den cover would thus be developing for mink.

Table 49. Mitigation HSI values for mink by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	**0.68**	**0.45**	**0.85**	**0.85**	**0.85**	0.68	0.68	0.68	0.68	0.68
Wetland - Farmed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Intertidal Emergent Wet.	0.85	**0.28**	**0.85**	**0.85**	**0.85**	0.85	0.85	0.85	0.85	0.85
Riparian	0.67	**0.22**	**0.67**	**0.67**	**0.67**	0.67	0.67	0.67	0.67	0.67
Riparian - Degraded	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian-Early Succ.	0.22	**0.00**	**0.22**	**0.45**	**0.67**	0.22	0.22	0.22	0.45	0.67
Riparian Assoc. Hab. - Degrad.	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Riparian Assoc. Hab.	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Riparian Assoc. Hab.- E.S.	0.22	**0.00**	**0.22**	**0.45**	**0.67**	0.22	0.22	0.22	0.45	0.67

Song Sparrow

Mitigation HSI values for song sparrows are provided in Table 49. Wetland habitat was projected to have an HSI value of 0.61 in TY1. Restoration of marsh habitat in TY1 should provide for tall emergent and grass-forb cover which the species would utilize. Shrubs would be absent in TY1, thus the quality value was projected to be 0.61 compared to the 0.89 value determined from field measurement of habitat variables. By TY5, the shrub component of the wetland would be in place and the HSI value for song sparrows was estimated to attain 0.89.

Intertidal emergent marsh developed in TY1 would not provide habitat value to song sparrows. A minor value, 0.10, was projected for intertidal marsh for TY5 through TY50 as song sparrows use the upper portion of intertidal marshes for foraging habitat.

Riparian and Riparian Associated Habitat were assigned a quality value of 0.13 in TY1 to reflect the lack of grass-forb and shrub recovery from the degraded condition they were in TY0. Removal of livestock would allow for the rapid recovery of the grass-forb and shrub understory

in Riparian and Riparian Associated Habitat, thus HSI values in subsequent target years were projected to match the value obtained from measurement of field variables.

Early successional riparian habitats were projected to have no HSI value in TY1, the year they would be planted or established naturally. The value for TY1 reflects a lack of vegetative structure. Grass-forb and shrub components of the habitat would be well developed by TY5, providing nesting and foraging habitat, thus the HSI value was projected to attain 0.40, comparable to the value derived from field measurements.

Table 50. Mitigation HSI values for song sparrows by habitat classification by target year for the with and without project conditions.

	WITH PROJECT					WITHOUT PROJECT				
Habitat	TY0	TY1	TY5	TY25	TY50	TY0	TY1	TY5	TY25	TY50
Wetland	0.89	0.61	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Intertidal Emergent Wet.	0.10	0.00	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Riparian	0.40	0.13	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian – Degraded	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian-Early Succ.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40
Riparian Assoc. Hab. - Degrad.	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Riparian Assoc. Hab.	0.40	0.13	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Riparian Assoc. Hab.- E.S.	0.13	0.00	0.40	0.40	0.40	0.13	0.13	0.40	0.40	0.40

5.2. HEP Analysis Mitigation

The accumulated information on habitat quantity and quality for each mitigation sites was then analyzed through the HEP process to determine the number of AAHUs generated at each site by the proposed mitigation measures. The HEP analysis was comparable to that described for disposal sites except results were calculated for each individual mitigation site. Further, analyses of mitigation actions, e.g., cost effectiveness, incremental cost analysis, were required after the HEP analysis, in order to determine which mitigation sites were most appropriate to select for implementation. And the nine mitigation sites subject to the detailed analyses were known to exceed the number of mitigation sites required to accomplish full mitigation for project-related impacts. Consequently, each mitigation site was considered in detail whereas disposal site analysis grouped all sites together to determine total project impact.

5.3. HEP Results for Mitigation Sites

The general results of the HEP analysis for the nine mitigation sites considered in detail are initially presented on site, species and habitat bases (Tables 51 and 52). Mitigation AAHUs presented in Table 51 were mathematically adjusted to eliminate bias associated with use of a different number of target species for each habitat. The mathematical adjustment was discussed in detail previously in the text under the section heading "HEP ANALYSIS."

Mitigation site AAHU totals vary considerably by location (Table 51). Mitigation site AAHU totals represent the net gain across all target species at a particular location. Mitigation implementation at Woodland Bottoms would generate the highest net gain in AAHUs. Implementation of mitigation actions at Burke Island would generate the lowest net gain in AAHUs amongst mitigation sites. Canada geese, mallards and savannah sparrows incur additional net losses in AAHUs at certain mitigation locations with implementation of mitigation actions (Table 51). These additional losses in AAHUs result from the development of wetland and riparian habitat at mitigation sites where the current land management emphasis is on agricultural crops. The reduction in habitat acreage and/or reduction in habitat quality for these three species accounts for a net loss in AAHUs at certain mitigation locations.

Table 51. AAHUs determined for target species at each potential mitigation site and site totals.

TARGET SPECIES	JOSLIN PROPERTY	VANCOUVER LOWLANDS	SAUVIE 94	WOODLAND BOTTOMS	BURKE ISLAND	MARTIN ISLAND	WEBB	PUGET ISLAND	SVENSEN ISLAND
All Habitats									
Amphibian	14.4	25.1	30.9	43.3	8.0	8.2	22.4	27.0	-47.7
Canada Goose	-21.3	79.8	19.9	11.3	-89.1	-74.9	-32.6	-56.4	-36.4
Mallard	13.2	0.0	6.6	10.5	-22.0	33.5	6.9	-13.1	84.9
Savannah Sparrow	-14.5	105.1	30.7	44.4	-58.2	-46.4	0.0	-34.4	-80.6
Black-capped Chickadee	11.0	0.0	3.1	7.0	19.2	38.4	6.8	12.0	-0.3
Yellow Warbler	12.4	0.0	3.5	9.5	26.2	47.0	9.1	16.3	0.8
Cooper's Hawk	21.7	0.0	6.2	15.2	41.8	79.0	14.6	26.2	0.5
Mink	50.6	0.0	50.0	74.3	57.3	85.3	76.0	40.0	174.7
Song Sparrow	47.2	0.0	50.9	76.6	55.5	53.7	78.4	39.1	21.1
Site Grand Total AAHU's	134.7	210.0	201.8	292.0	38.8	223.8	181.6	56.7	117.0

Mitigation management measures are targeted to produce wetland, riparian and/or agricultural (winter pasture for Canada geese) habitat. AAHUs that result from management actions targeted for these general habitats are identified in Table 52. Management of Svensen Island (breaching dikes) would result in a substantial gain in AAHUs for wetland target species compared to other sites. Wetland AAHUs generated at the other potential mitigation sites are roughly comparable (Table 52), except for Vancouver Lowlands and Svensen Island. Management of Vancouver Lowlands to produce winter forage for Canada geese would not generate any AAHUs for wetland target species.

A management emphasis on riparian habitat would produce the most AAHUs for riparian target species at Martin Island (Table 52). Vancouver Lowlands and Svensen Island management actions, that favor either winter pasture for Canada geese or wetland habitat, do not generate few or no AAHUs for riparian target species (Table 52). Variable levels of riparian target species AAHUs are produced at other mitigation sites.

Five of the nine mitigation sites exhibit a loss in AAHUs for agricultural related target species (Table 52). The mitigation emphasis on production of wetland and/or riparian habitat contributes directly to the loss in agricultural target species AAHUs identified at five mitigation sites. Vancouver Lowlands, where the management emphasis was on production of Canada goose forage, exhibits the most net gain in AAHUs for agricultural target species.

Table 52. AAHUs determined for target species, three general habitats and each potential mitigation site.

TARGET SPECIES	JOSLIN PROPERTY	VANCOUVER LOWLANDS	SAUVIE 94	WOODLAND BOTTOMS	BURKE ISLAND	MARTIN ISLAND	WEBB	PUGET ISLAND	SVENSEN ISLAND
				Wetland					
Amphibian	15.5	0.0	21.5	20.9	15.2	1.6	16.8	13.2	-2.4
Canada Goose	6.0	0.0	10.0	-16.6	12.4	12.7	-32.6	3.5	104.2
Mallard	14.3	0.0	20.8	4.6	17.9	24.9	-7.8	9.0	197.3
Savannah Sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black-capped Chickadee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow Warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cooper's Hawk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mink	33.2	0.0	45.0	63.6	27.8	25.5	65.6	21.6	175.0
Song Sparrow	35.1	0.0	47.5	67.2	29.4	7.2	69.2	22.8	20.3
Wetland Total AAHUs	104.0	0.0	144.9	139.7	102.8	71.9	111.3	70.1	494.4
				Riparian					
Amphibian	6.9	0.0	2.4	5.4	15.9	21.2	5.6	13.7	-1.9
Canada Goose	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mallard	19.6	0.0	5.5	15.2	42.2	74.9	14.7	26.4	1.3
Savannah Sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black-capped Chickadee	11.0	0.0	3.1	7.0	19.2	38.4	6.8	12.0	-0.3
Yellow Warbler	12.4	0.0	3.5	9.5	26.2	47.0	9.1	16.3	0.8
Cooper's Hawk	21.7	0.0	6.2	15.2	41.8	79.0	14.6	26.2	0.5
Mink	17.4	0.0	5.0	10.7	29.4	59.9	10.3	18.4	-0.3
Song Sparrow	12.2	0.0	3.4	9.5	26.2	46.5	9.1	16.3	0.8
Riparian Total AAHUs	101.1	0.0	29.3	72.4	201.0	366.8	70.3	129.4	0.9
				Agriculture					
Amphibian	-7.9	25.1	7.0	16.9	-23.1	-14.6	0.0	0.0	-43.4
Canada Goose	-27.3	79.8	9.8	27.9	-101.6	-87.6	0.0	-59.9	-140.6
Mallard	-20.7	0.0	-19.8	-9.4	-82.1	-66.4	0.0	-48.5	-113.7
Savannah Sparrow	-14.5	105.1	30.7	44.4	-58.2	-46.4	0.0	-34.4	-80.6
Black-capped Chickadee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow Warbler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cooper's Hawk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mink	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Song Sparrow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture Total AAHUs	-70.4	210.0	27.7	79.8	-265.0	-214.9	0.0	-142.7	-378.3

The determination of which wildlife mitigation actions will be implemented to offset project-related losses is dependent upon economic analyses of implementation costs and AAHU production for each potential mitigation site. Those analyses will identify the most cost efficient mitigation sites to be selected. Mitigation actions are identified for each alternative and separable disposal plans for the structural alternatives in the following text.

6. WILDLIFE MITIGATION FOR EACH STUDY ALTERNATIVE

6.1. No Action Alternative

No compensatory mitigation measures were employed for this alternative as disposal site selection focused on use of existing dredged material disposal sites and avoidance, to the extent practicable, of riparian and wetland habitat at these locations.

6.2. Non-Structural Alternative

No compensatory mitigation measures were employed for this alternative, as it is identical to the No Action Alternative.

6.3. Structural Alternatives: 41'X600', 42'X600', AND 43'X600' Channels

Two distinct disposal plans, Government and Sponsor Preferred, have been developed for the Structural Alternatives. These disposal plans address all three channel depths proposed through variation in the height of disposal. Thus, the acreage impacted by disposal actions in each disposal plan does not vary by channel depth. Both disposal plans would require compensatory mitigation to offset wildlife habitat impacts associated with use of upland disposal sites. The nine potential mitigation sites, which could provide compensatory mitigation for disposal impacts, have also been discussed in the preceding text. The initial selection of the appropriate mitigation site(s) is based upon cost effectiveness and incremental cost analyses. These analyses, for the mitigation actions associated with the two disposal plans, have considerable overlap. Consequently, the subsequent text presents a combined analysis for the Government and Sponsor Preferred Disposal Plan mitigation.

7. COST EFFECTIVENESS AND INCREMENTAL COST ANALYSIS

In conjunction with the environmental analysis of potential mitigation sites, ER1105-2-100 (28 Dec 90) requires cost effectiveness and incremental cost analyses of potential mitigation strategies. The following information provides a description of these analyses.

Cost effectiveness analysis and incremental cost analysis are both required for mitigation analysis. The following explanations clarify the difference between them and the purpose for each analysis.

- *Cost effectiveness analysis* is conducted to ensure that the least cost solution is identified for each possible level of environmental output. Its purpose is to eliminate

inefficient management measures or combinations of measures, based on comparing habitat units with *average cost* of a measure or combinations of measures. Measures/combinations are ranked by habitat unit outputs, then the costs of plans that have *similar habitat unit outputs* are compared, and the least-cost solution for that level of habitat unit output is selected.

- *Incremental cost analysis* is conducted to show changes in costs for increasing levels of environmental outputs. It provides data for decision-makers to address the question "Is the next level worth it?". It measures the incremental or *additional cost* of the next additional level of habitat unit output. Once costs have been estimated for mitigation plan increments, costs are arrayed from lowest to highest cost per unit of output.

Guidance (ER 1105-2-100, 7-35. H.) requires that the least cost mitigation plan (that provides full mitigation of the losses specified in the mitigation planning objectives) be identified and displayed. The recommended plan, if different, will be compared to it.

7.1. Terminology

Management measures are different methods that can be used to meet a mitigation objective. At a particular site, more than one management measure may be viable. Action alternatives are comprised of one or more measures intended to cause a desirable change in environmental output.

In this study, action alternatives at a site will be defined in such a way that individual stand-alone measures will comprise an action alternative, as well as appropriate combinations of combinable measures (so that no further analysis of combinables will be necessary at the site level). As a result, incremental analysis is based on levels of output from various action alternatives, not on increased output from specific measures within that action alternative.

In this analysis, there are multiple potential mitigation sites. The first iteration of the mitigation analysis will be based on a site by site basis, since each site has different attributes and capacities. After the site by site analysis has been completed, a second iteration of the analysis will be done on a system basis considering multiple sites. This will identify the most cost-effective mitigation action alternatives for the system.

7.2. How Many Increments?

One of the important issues in mitigation analysis is how many increments and measures to study. The IWR Publication entitled "Cost Effectiveness Analysis for Environmental Planning: Nine EASY Steps" offers the following guidance to direct the effort.

Cost effectiveness and incremental cost analyses become more complicated, more costly, and more time consuming as more increments of management measures and alternative plans are included. There are no universal rules for determining the number of increments of management

measures or alternative plans to be considered. Rather, judgment is used to determine a set of increments that are:

- Meaningful
- Practical (implementable)
- Revealing (adequate to reveal significant changes in outputs or costs)
- Reasonable (a reasonable balance between the needs and the constraints of a study; sometimes only a few solutions will be reasonable)

(Source: "Cost Effectiveness Analysis for Environmental Planning: Nine EASY Steps", IWR Report 94-PS-2, October 1994, p.53)

A screening process was used to help narrow the number of management measures and action alternatives that would require a baseline cost estimate level of detail for the incremental analysis. For instance, when it was clear that the costs of one management measure exceeded those of another management measure, and that the measures would result in similar habitat outputs, the lower cost measure was carried forward, and the higher cost measure was dropped from further consideration. These estimates of cost and quantities for various measures were based on discussions with design engineers. This screening process accommodates the required balance between the analytical needs of cost-effectiveness and incremental cost analyses, and the constraints of the study.

Another common sense screening approach was to focus on action alternatives that would achieve mitigation for the variety of types of losses that would occur as a result of the channel deepening project and/or were ecosystem oriented. For instance, for a given mitigation site it is possible to simply acquire the site and prescribe no management actions. Potentially, this might result in a small but positive impact on habitat units on the site. However, as part of the screening process used in this analysis, these no prescription options were dropped from further consideration. Instead, the focus was placed on managing mitigation sites to increase the habitat unit outputs. Physical characteristics of each site were taken into account to focus on action alternatives that would make the best use of the site to increase the habitat unit outputs. For example, if a specific site was particularly low in ground elevation and adjacent to a potential water source, it might be considered as a site for wetland habitat development rather than agricultural habitat development management for geese.

Additionally, the acres designated for various types of habitat development (wetland, riparian, and agricultural crops for waterfowl forage) at each site were based on the suitability of the landforms to specific types of habitat development.

7.3. Calculating Average Annual Costs

In order to compare costs with average annual habitat units, it was necessary to convert implementation costs to average annual costs. The costs included: acquisition costs; development costs; operation, maintenance, periodic replacement costs, and monitoring costs. The stream of costs occurs at various points in time. Therefore, all costs were present-valued (or future-valued) to the beginning of the period of analysis (at the expected project on-line date of

2004), and amortized at the FY98 Federal discount rate of 7.125 percent over the 50-year project life, to develop equivalent average annual costs. (Note that guidance on calculation of average annual habitat units makes use of a different process. Habitat units are not discounted. Rather, the stream of annual habitat unit values is summed over the period, then divided by the number of years to estimate average annual habitat units.)

For determining the economic cost of the project and its various components, including mitigation, a calculation to determine the cost of interest during construction (IDC) is required. IDC is added to the other costs of mitigation, and included as part of the average annual cost of mitigation. The IDC is based on the level of construction costs expended during the construction period prior to the in-service date, and is included as an economic cost, but is not included as a financial cost. IDC was calculated using the FY98 discount rate of 7.125 percent for annual payments incurred up to the project on-line date. (Note that the IDC is not double-counted and is equivalent to the future valuing of costs prior to the project on-line date.)

Costs for various measures were developed on a site-specific basis, since costs vary by site. Consequently, average annual costs and average annual habitat units were developed on a site by site basis. Certain costs are required to prepare individual sites for implementation of various action alternatives. Site preparation costs may include removal of blackberries, removal of old fencing, clean-up of auto bodies and miscellaneous trash, and so forth, varying by site. The applicable cost of site preparation is included in each impacted action alternative, so that all action alternatives are treated on an equal basis. This eliminates the need for an additional first-added analysis of action alternatives at a specific site.

7.4. Cost Effectiveness

As previously noted, cost effectiveness analysis is required for potential mitigation strategies. Cost effectiveness is a measure of the average annual cost for various levels of output for a plan. Its purpose is to eliminate inefficient plans. The first iteration of cost effectiveness analysis is on a site by site basis. Then, a second iteration of cost effectiveness analysis considers multiple sites along the lower Columbia River.

7.5. Summary of Site By Site Cost Analysis

Table 53 summarizes the average annual costs for various action alternatives at a site, the net gains in average annual habitat unit outputs, and the average annual cost per habitat unit for each action alternative on a site by site basis. As Table 53 shows, the average annual cost per habitat unit is directly associated with the number of AAHUs gained (or lost) by development of various action alternatives at a site. Note that AAHUs in the following cost effectiveness analysis are based upon **net** gains (losses), rather than total AAHUs. Consequently, the AAHU numbers do not directly match total AAHU numbers in preceding tables.

Table 53. Summary of sites, action alternatives, average annual costs, average annual habitat units, and average annual cost per habitat unit.

SITE	ACTION ALTERNATIVE	$AACOST	AAHUS	$AAC/HU
Joslin Property	Wetlands	$72,606	63.9	$1,136
	Riparian Forest	$70,518	70.8	996
	Wetlands/Riparian	$76,135	134.7	565
Vancouver Lowlands	Ag Crops for Waterfowl Forage	$302,238	210	1,439
Sauvie 94	Wetlands	143,015	144.9	987
	Riparian Forest	139,208	29.3	4,751
	Ag Crops (Waterfowl Forage)	151,322	27.7	5,463
	Wetlands/Riparian	142,104	174.2	816
	Wetlands & Ag Crops	157,038	172.6	910
	Riparian & Ag Crops	153,230	57	2,688
	Wetlands/Riparian/Ag Crops	158,945	201.9	787
Burke Island	Wetlands	75,172	48.1	1,563
	Riparian Forest	80,132	-9.3	(8,616)
	Wetlands/Riparian	83,685	38.8	2,157
Woodland Bottoms	Wetlands	156,006	139.7	1,117
	Riparian Forest	155,618	72.4	2,149
	Ag Crops (Waterfowl Forage)	168,353	79.8	2,110
	Wetlands/Riparian	160,042	212.1	755
	Wetlands & Ag Crops	172,798	219.5	787
	Riparian & Ag Crops	172,411	152.2	1,133
	Wetlands/Riparian/Ag Crops	176,812	291.9	606
Martin Island	Wetlands	110,874	71.9	1,542
	Riparian Forest	103,767	151.9	683
	Wetlands/Riparian	123,025	223.8	550
Webb Property	Wetlands	63,287	111.3	569
	Riparian Forest	64,198	70.3	913
	Wetlands/Riparian	68,657	181.6	378
Puget Is. (Vik)	Wetlands	81,316	56.5	1,439
	Riparian Forest	83,171	0.3	277,237
	Wetlands/Riparian	91,928	56.8	1,618
Svensen Island	Wetlands	134,413	121.1	1,110
	Wetlands/Riparian	136,463	117	1,166

Action alternatives that resulted in the most cost-effective outputs were selected from the previous site by site analysis, for further consideration. (As noted earlier, the action alternatives at a given site were set up so that they were mutually exclusive.)

Table 54 summarizes the average annual habitat unit outputs, average annual costs, and average annual cost per habitat unit, of the most cost-effective action alternative at a site. For easy reference, the sites are ranked in ascending order based on average annual cost per habitat unit. Note that six of the sites include the full development action alternative, while three of the sites (as indicated in the table) showed development of wetlands as the most cost-effective action alternative.

Table 54. Summary of cost effective alternatives by site, average annual habitat units, average annual cost, and average annual cost per habitat unit.

SITE	AAHUS	AACOST	$AAC/HU
Webb Property	181.6	$68,657	$378
Martin Island	223.8	123,025	550
Joslin Property	134.7	76,135	565
Woodland Bottoms	291.9	176,812	606
Sauvie 94	201.9	158,945	787
Svensen Island (Wetlands)	121.1	134,413	1,110
Vancouver Lowlands	210	302,238	1,439
Puget Island (Vik) (Wetlands)	56.5	81,316	1,439
Burke Island (Wetlands)	48.1	75,172	1,563

The basic components of the following system cost effectiveness analysis are the average annual habitat units and the average annual costs for individual sites, as displayed in Table 54.

7.6. Summary of System Cost Effectiveness

A second iteration of the cost effectiveness analysis was necessary to consider multiple sites along the lower Columbia River system. The following table displays the cost-effective least-cost combinations of sites for the system. Note that in the following system cost effectiveness analysis, the combinations of sites are not mutually exclusive.

Guidance (ER1105-2-100, 7-35. H.) directs that the least cost mitigation plan that provides full mitigation of losses specified in mitigation planning objectives be identified. Losses for the Government Disposal Plan came to 972 average annual habitat units. Losses for the Sponsor Preferred Disposal Plan came to 482 average annual habitat units.

Note that with nine sites, there are in excess of five hundred combinations of sites. In order to facilitate the required calculations, the IWR "Cost Effectiveness and Incremental Cost Analysis" (Eco-Easy) software program was used. Rather than attempting to display all of the combinations of sites, two tables will be used to summarize the results: the cost-effective least-cost combinations; and the combinations from the final incremental cost analysis.

The combinations listed in Table 55 are the cost-effective least-cost combinations. They are listed in ascending order of average annual habitat units for the combinations.

Table 55. Cost effective least-cost combinations for the system average annual habitat units and average annual cost.

SITE COMBINATIONS	AAHUS	AACOST
A. Webb	181.6	$68,657
B. Martin	223.8	$123,025
C. Webb, Burke	229.7	$143,829
D. Webb, Joslin	316.3	$144,792
E. Martin, Webb	405.4	$191,682
F. Woodland, Webb	473.5	$245,469
G. Martin, Webb, Joslin	540.1	$267,817
H. Woodland, Webb, Joslin	608.2	$321,604
I. Woodland, Martin, Webb	697.3	$368,494
J. Martin, Sauvie 94, Webb, Joslin	742	$426,762
K. Woodland, Martin, Webb, Burke	745.4	$443,666
L. Woodland, Martin, Webb, Joslin	832	$444,629
M. Woodland, Martin, Webb, Joslin, Burke	880.1	$519,801
N. Woodland, Martin, Webb, Joslin, Puget (Vik)	888.5	$525,945
O. Woodland, Martin, Sauvie 94, Webb	899.2	$527,439
P. Woodland, Martin, Webb, Joslin, Svensen	953.1	$579,042
Q. Woodland, Martin, Sauvie 94, Webb, Joslin	1033.9	$603,574
R. Woodland, Martin, Sauvie 94, Webb, Joslin, Burke	1082	$678,746
S. Woodland, Martin, Sauvie 94, Webb, Joslin, Puget (Vik)	1090.4	$684,890
R. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen	1155	$737,987
S. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen, Burke	1203.1	$813,159
T. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik)	1211.5	$819,303
U. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik), Burke	1259.6	$894,475
V. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Burke	1292	$980,984
W. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Puget (Vik)	1300.4	$987,128
X. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen	1365	$1,040,225
AA. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen, Burke	1413.1	$1,115,397
BB. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik)	1421.5	$1,121,541
CC. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik), Burke	1469.6	$1,196,713

As previously noted, losses for the Government Disposal Plan came to 972 average annual habitat units, and losses for the Sponsor Preferred Disposal Plan came to 482 average annual habitat units. In Table 55, combination Q is the first cost-effective combination that would meet the objective of full mitigation for the loss of 972 AAHUs. Combination G is the first cost-effective combination that would meet the objective of full mitigation for the loss of 482 AAHUs.

Table 55 also displays the supply schedule of the average costs per level of output, which summarizes the data that serves as the basis from which to derive the incremental cost analysis.

7.7. Incremental Cost Analysis

Table 56 shows the final incremental cost analysis. Incremental cost analysis is required to address whether the incremental or additional cost of the next level of output is worth it. In environmental studies, the comparison is between dollar incremental costs and non-dollar incremental units of output (AAHUs).

In order to facilitate the required calculations, the IWR "Cost Effectiveness and Incremental Cost Analysis" (Eco-Easy) software program was used to do the calculations necessary to eliminate the irregular, non-continuously increasing cost changes that occur in the incremental average annual cost per output calculations. To get to the final incremental cost table, it was necessary to do a series of calculations to determine the lowest average cost for additional output from amongst the remaining levels of output. Each of the recalculations begins with the previous step's lowest average cost level of output set as the new "zero level". The calculation in this step uses the additional cost and additional outputs above those of the previously identified level of output with the lowest average cost. (For further details on this process, please refer to "Cost Effectiveness Analysis for Environmental Planning: Nine Easy Steps", IWR Report 94-PS-2, October 1994.) Table 56 summarizes the results of the final incremental cost analysis.

Table 56. Summary of final incremental cost analysis.

COMBINATIONS	TOTAL AACOST	TOTAL AAHUS	ADDED AAHUS	ADDED AACOST	INCREMENTAL $AAC/HU
A. Webb	$68,657	181.6	181.6	$68,657	$378
E. Martin, Webb	$191,682	405.4	223.8	$123,025	$550
G. Martin, Webb, Joslin	$267,817	540.1	134.7	$76,135	$565
L. Woodland, Martin, Webb, Joslin	$444,629	832	291.9	$176,812	$606
Q. Woodland, Martin, Sauvie 94, Webb, Joslin	$603,574	1033.9	201.9	$158,945	$787
T. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen	$737,987	1155	121.1	$134,413	$1,110
V. Woodland, Martin, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik)	$819,303	1211.5	56.5	$81,316	$1,439
BB. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik)	$1,121,541	1421.5	210	$302,238	$1,439
CC. Woodland, Martin, Vanc. Low, Sauvie 94, Webb, Joslin, Svensen, Puget (Vik), Burke	$1,196,713	1469.6	48.1	$75,172	$1,563

Table 56 shows the change from one combination to the next. For instance, moving from combination A to combination E shows: 1. a change of 223.8 additional average annual habitat units (405.4 total AAHUs for combination E minus 181.6 total AAHUs for combination A); 2.

an additional average annual cost of $123,025 ($191,682 total average annual cost for combination E minus $68,657 total average annual cost for combination A); and, 3. an additional or incremental $550 average annual cost per average annual habitat unit ($123,025 additional or incremental cost divided by 223.8 AAHUs additional or incremental AAHU output).

The column on the right (Table 56) summarizes the incremental average annual cost per output and shows potential breakpoints where gaining the next level of output would result in a marked increase in costs. For instance, there appear to be significant breakpoints in incremental average annual cost per output between combinations Q and T, and also between combinations T and V. While the incremental average annual cost per output increases for combinations T and V, there are much smaller incremental gains in output for those combinations.

7.8. Conclusions

It should be noted that cost effectiveness and incremental cost analyses alone do not result in a unique mitigation plan recommendation. However, for the Government Disposal Plan, that required mitigation of 972 AAHUs, it is evident that combination Q meets the requirement (ER1105-2-100, 7-35. H.) that the cost-effective, least cost mitigation plan that provides full mitigation of losses specified in mitigation planning objectives be identified. The incremental cost analysis shows a significant breakpoint in incremental average annual cost per output between combinations Q and T.

For the Sponsor Preferred Disposal Plan that required mitigation of 482 AAHUs, combination G meets the requirement that the cost-effective, least cost mitigation plan that provides full mitigation of losses be identified. The incremental cost analysis shows a breakpoint in incremental average annual cost per output between combinations G and L, but the breakpoint is not as significant as at higher levels of output.

It is economically rational to increase production so long as there is a positive return (output) on the additional investment. In this case, the comparison is between dollar incremental costs and non-dollar incremental units of output. Consequently, decision makers have to base subjective judgments about the value of the output being produced on information other than cost effectiveness and incremental costs analyses (such as relative scarcity of output, or significance of the output).

7.9. Wildlife Mitigation Actions at Cost -Effective Plan Sites

7.9.1. Government Disposal Plan Mitigation

Mitigation to offset project-related losses associated with implementation of the Government Disposal Plan can be attained through use of five mitigation sites, e.g., Joslin, Sauvie 94, Woodland Bottoms, Martin Island and Webb. These five locations, encompassing 1,137 acres, were determined to produce sufficient AAHU's (e.g., 1,033) to offset project related losses (e.g. 972 AAHU's). Mitigation management actions would entail use of 1,027 acres of the total acreage on these 5 sites. Wetland habitat development or improvements would occur on 355

acres. Riparian habitat development or improvement would encompass 424 acres. Agricultural management, e.g. permanent pastureland, would occur on 248 acres.

Those target species that represent wetland and riparian habitat exhibit the most net gain in AAHUs across the 5 mitigation sites (Table 57). Mink and song sparrow constitute more than one-half of the total AAHUs produced at these mitigation sites. Canada geese, because wetland and riparian habitat development would occur via conversion of agricultural lands, would incur a net loss in AAHUs with implementation of this mitigation plan (Table 57).

Table 57. Target species, mitigation site and total AAHUs for proposed mitigation for the Government Disposal Plan.

TARGET SPECIES	JOSLIN PROPERTY	SAUVIE 94	WOODLAND BOTTOMS	MARTIN ISLAND	WEBB	SPECIES TOTALS
Amphibian	14.4	30.9	43.3	8.2	22.4	119.2
Canada Goose	-21.3	19.9	11.3	-74.9	-32.6	-97.5
Mallard	13.2	6.6	10.5	33.5	6.9	70.6
Savannah Sparrow	-14.5	30.7	44.4	-46.4	0.0	14.2
Black-capped Chickadee	11.0	3.1	7.0	38.4	6.8	66.3
Yellow Warbler	12.4	3.5	9.5	47.0	9.1	81.5
Cooper's Hawk	21.7	6.2	15.2	79.0	14.6	136.6
Mink	50.6	50.0	74.3	85.3	76.0	336.2
Song Sparrow	47.2	50.9	76.6	53.7	78.4	306.8
Total Adjusted AAHU's	134.7	201.8	292.0	223.8	181.6	1033.9

7.9.2. Sponsor Preferred Disposal Plan

Mitigation to offset project-related losses associated with implementation of the Sponsor Preferred Disposal Plan can be attained through use of three mitigation sites, e.g., Joslin, Martin Island and Webb. These three locations, encompassing 648 acres, were determined to produce sufficient AAHU's (e.g., 540; Table 58) to offset project related losses (e.g. 482 AAHU's). Mitigation management actions would entail use of 549 acres of the total acreage on these 3 sites. Wetland habitat development or improvements would occur on 189 acres. Riparian habitat development or improvement would encompass 360 acres. No agricultural management, e.g. permanent pastureland, would occur under this management scenario.

Table 58. Proposed Mitigation for Sponsor Disposal Plan.

TARGET SPECIES	JOSLIN PROPERTY	SAUVIE 94	WEBB	SPECIES TOTALS
Amphibian	14.4	8.2	22.4	45.0
Canada Goose	-21.3	-74.9	-32.6	-128.7
Mallard	13.2	33.5	6.9	53.6
Savannah Sparrow	-14.5	-46.4	0.0	-60.9
Black-capped Chickadee	11.0	38.4	6.8	56.1
Yellow Warbler	12.4	47.0	9.1	68.5
Cooper's Hawk	21.7	79.0	14.6	115.3
Mink	50.6	85.3	76.0	211.9
Song Sparrow	47.2	53.7	78.4	179.3
Total AAHU's	134.7	223.8	181.6	540.1

Results of the mitigation action for the Sponsor Preferred Disposal Plan show that mitigation AAHUs accrued for those target species that use riparian and wetland habitat (Table 58). Canada geese and savannah sparrows incurred net losses in AAHUs with mitigation implementation at these locations. As noted above, the conversion of agricultural lands to wetland and riparian habitat has a deleterious effect on those species associated with agricultural and grasslands.

Mitigation results for individual mitigation properties are described in the following paragraphs. Again all five sites would be utilized to offset project impacts of the Government Disposal Plan; only three sites are considered to offset project impacts for the Sponsor Preferred Plan.

Joslin Property, located at the upstream tip of Sauvie Island, would produce 134.7 AAHU's when managed to produce riparian and wetland habitat. Wetland development or improvement would occur on 50 acres and 73 acres of riparian habitat would be established or improved. Removal of cattle grazing would improve habitat conditions for existing wetland and riparian habitat. Water control structures would improve existing wetland habitat and allow for the development of additional wetland habitat. A portion of the property would be planted to riparian forest trees.

Sauvie 94, located at CRM 94 on Sauvie Island would produce 201.9 AAHU's from wetland, riparian and agricultural crop production for wildlife (e.g. permanent pastureland for Canada goose forage). Sixty-eight acres of wetland would be developed through placement of water control structures or improved through removal of cattle. Twenty acres of riparian forest would be established through plantings or improved via removal of grazing pressure. Permanent pastureland would be planted on 116 acres.

The Woodland Bottoms location, near Woodland, Washington, would produce 291.9 AAHU's derived from wetland, riparian and agricultural crop production for wildlife (e.g. permanent pastureland for Canada goose forage). Ninety-seven acres of wetland habitat would either be developed or improved. Removal of cattle from the existing wetland habitat would result in the

majority of wetland habitat gains. Riparian forest would be planted on 44 acres. Permanent pastureland would be planted on 132 acres.

Riparian and wetland habitat development at Martin Island (CRM 80) would produce an estimated 223.8 AAHU's. Removal of cattle grazing and riparian plantings would result in 244 acres of riparian habitat at Martin Island. Filling an embayment and improvements to an existing wetland would provide 39 acres of wetland habitat at Martin Island.

The Webb location near Westport, Oregon would produce 181.6 AAHU's from wetland and riparian forest management. Improvements and development would produce 100 acres of wetland habitat. Riparian forest plantings would encompass 43 acres.

7.9.3. Factors Affecting Selection of a Proposed Mitigation Plan for the Sponsor Preferred Disposal Plan

The proposed plan for mitigation is typically based upon the selection of the most cost efficient, incrementally justified mitigation actions. Societal/political considerations may result in selection of different mitigation actions. Local opposition or an owner's refusal to sell could lead to selection of different mitigation locations. Port and resource agency representatives have both voiced their reluctance to purchase and manage/administer controversial sites.

The cost effective, incrementally justified and sponsor preferred mitigation plan to offset project-related impacts of the Sponsor Preferred Disposal Plan does not equitably distribute mitigation efforts between Washington and Oregon. This lack of equitability was the subject of discussion between the project sponsors, Corps of Engineers and state resource agencies. It was concluded that a more equitable plan for mitigation would be developed.

The Sponsor Preferred Disposal Plan would result in a loss of 380 AAHUs in Washington and 102 AAHUs in Oregon. A more balanced combination of mitigation sites would be comprised of Martin Island and Woodland Bottoms in Washington and the Webb location in Oregon. This balanced combination would produce 516 AAHUs in Washington and 182 AAHUs in Oregon. The average annual cost of the balanced mitigation plan is $368,500 versus $267,800 for the cost effective, incrementally justified and sponsor preferred mitigation plan. The balanced plan also produces 698 AAHUs versus a mitigation requirement of 482 AAHUs.

The balanced mitigation plan would encompass approximately 808 acres of land of which mitigation actions would occur on 700 acres. Mitigation lands in Oregon encompass 147 acres; 661 acres on two parcels would occur in Washington. Approximately 143 acres of the Webb location in Oregon would be used for mitigation actions; 557 acres of mitigation measures would occur on the two Washington parcels. Wetland habitat development would occur on 236 acres; 100 acres of wetland development would occur in Oregon. Riparian habitat development would encompass 331 acres of which all but 43 acres would occur in Washington. The balanced mitigation plan also includes agricultural forage development on 132 acres in Washington.

Similar to the other mitigation plans discussed previously, the balanced mitigation plan would result in the most AAHUs occurring for those species associated with wetland and riparian

habitat (Table 59). Again, because wetland and riparian habitat would be developed on lands currently in some form of agricultural use, Canada geese and savannah sparrows would incur losses in AAHUs (Table 59).

Table 59. Proposed Mitigation for Sponsor Disposal Plan with an equitable distribution of mitigation AAHUs between Oregon and Washington.

TARGET SPECIES	WOODLAND BOTTOMS	MARTIN ISLAND	WEBB	SPECIES TOTALS
Amphibian	43.3	8.2	22.4	73.9
Canada Goose	11.3	-74.9	-32.6	-96.1
Mallard	10.5	33.5	6.9	50.9
Savannah Sparrow	44.4	-46.4	0.0	-2.0
Black-capped Chickadee	7.0	38.4	6.8	52.1
Yellow Warbler	9.5	47.0	9.1	65.6
Cooper's Hawk	15.2	79.0	14.6	108.8
Mink	74.3	85.3	76.0	235.6
Song Sparrow	76.6	53.7	78.4	208.7
Total Adjusted AAHU's	292.0	223.8	181.6	697.4

7.9.4 Summary of Costs for Each Mitigation Plan

A summary of costs for each mitigation plan is provided in Table 60. It shows costs for: implementation and real estate acquisition; operation, maintenance, monitoring, administration; interest during construction; and the sum of these average annual costs, using 0.7125 interest and amortization factors.

Table 60. SUMMARY OF AVERAGE ANNUAL COST COMPONENTS OF PLANS

GOVERNMENT DISPOSAL PLAN COST-EFFECTIVE MITIGATION PLAN

MITIGATION SITE	IMPLEMENTATION COST W/ REAL ESTATE	O&M COST	IDC	SUM
Webb Property	$ 30,647	$ 35,091	$ 2,919	$ 68,657
Martin Island	$ 87,040	$ 27,889	$ 8,096	$ 123,025
Joslin Property	$ 38,319	$ 34,086	$ 3,730	$ 76,135
Woodland Bottoms	$ 89,158	$ 78,562	$ 9,092	$ 176,812
Sauvie 94	$ 75,200	$ 76,091	$ 7,654	$ 158,945
AA SUM:	$ 320,364	$ 251,719	$ 31,491	$ 603,574

Table 60. CONTD. SUMMARY OF AVERAGE ANNUAL COST COMPONENTS OF PLANS

SPONSOR PREFERRED DISPOSAL PLAN COST-EFFECTIVE MITIGATION PLAN

MITIGATION SITE	IMPLEMENTATION COST W/ REAL ESTATE	O&M COST	IDC	SUM
Webb Property	$ 30,647	$ 35,091	$ 2,919	$ 68,657
Martin Island	$ 87,040	$ 27,889	$ 8,096	$ 123,025
Joslin Property	$ 38,319	$ 34,086	$ 3,730	$ 76,135
AA SUM:	$ 156,006	$ 97,066	$ 14,745	$ 267,817

SPONSOR PREFERRED DISPOSAL PLAN BALANCED MITIGATION PLAN

MITIGATION SITE	IMPLEMENTATION COST W/ REAL ESTATE	O&M COST	IDC	SUM
Webb Property	$ 30,647	$ 35,091	$ 2,919	$ 68,657
Martin Island	$ 87,040	$ 27,889	$ 8,096	$ 123,025
Woodland	$ 89,158	$ 78,562	$ 9,092	$ 176,812
AA SUM:	$ 206,845	$ 141,542	$ 20,107	$ 368,494

7.9.5 Proposed Mitigation Plan

Separate mitigation plans are presented for the Government and Sponsor Preferred Disposal Plans during this review phase. The least cost mitigation plan is proposed for implementation if the Government Disposal Plan is the selected plan. Two options are available to mitigate impacts associated with the Sponsor Preferred Disposal Plan. The least cost mitigation plan for the Sponsor Preferred Disposal Plan offsets project-related impacts but does not equitably distribute mitigation actions between Oregon and Washington. The balanced mitigation plan equitably distributes mitigation actions between Oregon and Washington at a slightly higher cost. The balanced mitigation plan is proposed if the Sponsor Preferred Disposal Plan is implemented.

8. SIGNIFICANCE OF WILDLIFE MITIGATION ACTIONS

Mitigation actions for either disposal plan will address a number of significant wildlife resources and habitats. Riparian habitat development as a mitigation action would address the losses to target species that serve as representatives of the wildlife community in that habitat. Migrant birds, protected by the Migratory Bird Conservation Act and the Migratory Bird Treaty Act, including neotropical migrants that are a focus of the national/international Partners in Flight conservation actions, will also benefit from development of riparian and wetland habitat with mitigation implementation. The mitigation actions will address ESA listed species, principally

bald eagles, but also provide Critical Habitat for Snake River salmonids. Columbian white-tailed deer would benefit from mitigation actions proposed within their range.

Wetland habitat developed or restored via project-related mitigation actions will offset impacts to target species and benefit many other wetland dependent or associated species, including waterfowl, wading birds, amphibians, furbearers and fisheries resources. Waterfowl are the focus of local, regional and national efforts under the North American Waterfowl Management Plan directed at habitat restoration and population recovery and maintenance.

Agricultural forage crops developed for mitigation purposes principally addresses wintering Canada geese. However, the management prescription for agricultural forage would allow for development of tall, dense grass-forb cover during the spring and summer months. Tall, dense grass-forb cover would provide habitat conditions for rodents, amphibians, red-tailed hawks, northern harriers, American kestrels and grassland-associated songbirds. Bird species referenced are protected by the Migratory Bird Conservation Act and the Migratory Bird Treaty Act, including neotropical migrants that are a focus of the national/international Partners in Flight conservation actions.

9. WILDLIFE MITIGATION MONITORING AND OPERATION AND MAINTENANCE

Monitoring, operation, and maintenance costs were developed for the 9 mitigation sites that were considered in the HEP and incremental/cost effective analyses. Infrastructure, monitoring and operation and maintenance features and costs for the 5 mitigation sites that are proposed for implementation, either under the Government or Sponsor Preferred (balanced) Disposal Plan are presented in Exhibit G.

Infrastructure costs for operation and maintenance of the mitigation sites are based upon the estimated requirements to run a National Wildlife Refuge (NWR). Conceptually, the mitigation sites would be managed as separate units of one NWR in order to estimate costs. It is acknowledged that State resource agencies and/or the USFWS may manage mitigation sites, however the approach to develop infrastructure costs was predicated upon a conceptual NWR model for practicable reasons.

Operation and maintenance costs were based upon the management prescriptions evaluated for each mitigation site. A description of O&M cost items and the timing of implementation is provided in Exhibit G. They include such items as blackberry removal, riparian replanting, fertilizer application, replacement of culverts and signage for the property.

Monitoring actions and costs generally occur in the first five years of the mitigation action and would entail determination of riparian seedling establishment and wetland species composition.